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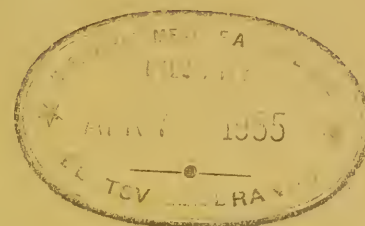
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# RANGE IMPROVEMENT STUDIES

AT THE  
U. S. SOUTHERN GREAT PLAINS FIELD STATION  
WOODWARD, OKLAHOMA  
1937-1954

Research conducted by the  
AGRICULTURAL RESEARCH SERVICE  
U. S. DEPARTMENT OF AGRICULTURE  
in cooperation with the  
OKLAHOMA AGRICULTURAL EXPERIMENT STATION





Eighteen-year Summary  
of  
RANGE IMPROVEMENT STUDIES  
at the  
U. S. Southern Great Plains Field Station  
Woodward, Oklahoma 1/  
by  
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RANGE IMPROVEMENT studies have been conducted at the U. S. Southern Great Plains Field Station, Woodward, Okla., since 1937. Grazing investigations with beef cattle were begun in 1941 and have been in progress for 12 years on the Southern Plains Experimental Range, a 4300-acre research unit located near Fort Supply, Okla. The soil and vegetation of the Experimental Range is characteristic of about 15 million acres of sand sagebrush rangeland in the Southern Great Plains.

Objectives of the studies have been to determine the most practical and profitable means of (1) reseeding grasses, (2) controlling brush and weeds, (3) managing native and reseeded grasslands, (4) supplementing range forage with protein, minerals, and other feeds, and (5) controlling external parasites on beef cattle.

This 18-year summary deals with major results, see previous reports for details.

Climatic Data

The average annual precipitation is 23 inches; elevation above sea level is 2000 feet; wind velocities and evaporation are high; and temperature extremes have varied from -28° F. in winter to 113° F. in summer. The average last frost in spring is April 10, while average first frost in fall is October 27.

A record-breaking drouth has occurred in the three years, 1952-53-54. Precipitation during the current grazing year, fall of 1953 to fall of 1954, was 12.62 inches or 10.29 inches below the 76-year average. Only 8.76 inches were received in the first 9 months of 1954. The long-time April-September precipitation has

- 1/ Eighteen-year (1937-54) progress report of the Forage and Range Section of the Field Crops Research Branch, AGRICULTURAL RESEARCH SERVICE, U. S. DEPARTMENT OF AGRICULTURE at the U. S. Southern Great Plains Field Station, Woodward, Oklahoma. This work was conducted with the excellent cooperation of the Oklahoma Agricultural Experiment Station; the Animal and Poultry Husbandry Research Branch, and the Production Economics Research Branch of ARS, USDA; the Soil Conservation Service; and other agencies and individuals.
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been 16.31 inches, and only 8.63 inches fell during that period in 1954. The average April-September precipitation for the past three years, 1952-53-54, was drier than that same period in any one or combination of the "infamous" 5-years, 1933-1937.

The first frost in fall of 1953 was on October 27, while the last frost in spring of 1954 was on May 3 — nearly a month later than average.

It was hot in 1954! The maximum temperature was over 100° F on 25 days in July and 18 days in August. Evaporation at Woodward was 16 percent above average, and wind velocity was 19 percent higher.

#### Average Grass Value and Steer Gains

Grasses of the region are highly nutritious during the growing season and retain their quality well when matured. However, investigations have shown that it is both practical and economical to supplement native range with protein in late summer if the grass is dry, and throughout the winter months. Phosphorus is adequate in the forage during summer but becomes borderline-deficient in winter.

| <u>Long-time trend in grass value and steer gains</u> |      |      |      |      |      |      |      |      |      |      |            |
|-------------------------------------------------------|------|------|------|------|------|------|------|------|------|------|------------|
| Items                                                 | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May  | June | July | Aug. | Sept.-Oct. |
| Grass Nutrients: <u>1/</u>                            |      |      |      |      |      |      |      |      |      |      |            |
| Protein, %                                            | 4.4  | 3.5  | 3.4  | 3.0  | 3.5  | 18.0 | 12.4 | 8.1  | 5.6  | 4.7  | 5.2        |
| Phosphorus, %                                         | .10  | .10  | .08  | .07  | .10  | .34  | .25  | .21  | .16  | .16  | .14        |
| Calcium, %                                            | .44  | .34  | .29  | .35  | .41  | .45  | .40  | .38  | .39  | .33  | .41        |
| Carotene, p.p.m.                                      | 17   | --   | 3    | --   | 13   | 449  | 236  | --   | 111  | --   | 71         |
| Steer gains:                                          |      |      |      |      |      |      |      |      |      |      |            |
| Daily per Hd.Lbs.                                     | .0   | .6   | .6   | .5   | .6   | 1.3  | 2.0  | 2.0  | 1.8  | 1.4  | 1.0        |
| Gain per Hd.Lbs.                                      | 0    | 20   | 17   | 15   | 18   | 38   | 62   | 59   | 55   | 42   | 37         |
| Accumulative gain per Hd.Lbs.                         |      |      |      |      | 70   | 108  | 170  | 229  | 284  | 326  | 363        |
| Percent of yearlong gain at end of month              |      |      |      |      |      |      |      | 63   | 78   | 90   | 100        |

The 10-year average gain per head of the experimental steers was 70 pounds in winter, 295 in summer, and 365 yearlong. Despite the current drouth conditions, the 1953-54 herd made excellent gains of 89 pounds per head in winter. Their summer gain, however, was only 210 pounds, the lowest on record.

#### Management of Cattle

A total of 300 to 600 Hereford steers were used each year in these investigations. Short-yearlings were used during the first 4 winters, weaner calves during the next 9 winters, and yearlings every summer. Weaner calves were taken directly from their mothers in mid-October, trucked or shipped to the Experimental Range, weaned on close-drilled sorghum, individually numbered with a hot-iron brand on their right hip, vaccinated for blackleg and malignant edema, castrated and dehorned when necessary, treated for ear ticks and lice, and allowed a period of 2 or more weeks to recover from these operations. The animals were then weighed individually on 2 or 3 successive days, and scored as to feeder grade by a committee of animal husbandmen. They were then allotted to the pastures on basis of initial weight and feeder grade.

1/ The analytical work was conducted through cooperation of the Department of Agricultural Chemistry Research, Oklahoma A. & M. College, and is reported in detail in USDA Technical Bulletin 943.





All animals except special test lots were treated for grub control and lice in winter and for horn fly control in summer. They usually were fed 2 pounds of 41 percent protein cottonseed cake daily during winter. Salt was kept before all animals continually. No other mineral was fed except in special tests.

After finishing 10 years of study with steers, about one-half of the experimental pastures were stocked with weaner heifers for the purpose of growing them into a breeding herd, and to use performance of cows and calves to measure results of certain grazing treatments. These cows have now weaned their second calves.

Management of 1953-54 steers: Paul Hatcher of Emporia, Kansas, was the ranchman cooperator for the steer herd during the 1953-54 grazing year. His 300 steers were purchased from the Mansfield Cattle Company, owned and operated by Jack and Bob Mansfield of Vega, Texas, for 20 cents per pound less 3 percent shrinkage. The steers were trucked to Woodward in mid-October 1953, and were processed in the regular manner. The average initial weight on test was 442 pounds per head, well above the "off-ranch" weight of 426 pounds 3 weeks earlier. They were placed on experimental pastures November 13, 1953. The winter season ended and the summer season began on April 21, 1954. The summer season will end October 15, 1954. This will make a total of 159 days of winter grazing and 177 of summer grazing or 336 yearlong. The steers were fed 284 pounds of 41 percent protein cottonseed cake during winter, compared with 255 pounds for the 13-year average.

Management of cow herd: J. O. Wells of Canadian, Texas, entered an agreement with the government in 1951 to furnish cows and bulls for a long-time grazing study. His 300 weaner heifer calves were purchased in October 1951 from J. B. Smith of Pawhuska, Oklahoma. They were well-wintered during 1951-52 on a total of 214 pounds of 41 percent protein cottonseed cake and 231 pounds of rolled sorghum grain per head. They were bred from June to August, 1952 using 1 bull per 25 heifers. Details of raising, breeding, and calving these heifers as well as the handling of the young bulls, were described in the Seventeen-year Summary which can be obtained from the Woodward Station. In brief, 89 percent of the two-year-old heifers calved on the average date, April 7, 1953. No heifers and only 8 percent of the calves were lost. Approximately half the heifers were assisted at birth. The sex-corrected weaning weight of all calves was 370 pounds on October 6, 1953. The cows weighed 895 pounds on this same date.

The cows were fed a total of 286 pounds of 41 percent protein cottonseed cake during the winter of 1953-54. A total of 184 cows, out of 220 — 84 percent — calved on the average date of March 28, 1954. The cows maintained their weight from weaning as "two's" to near weaning time as "three's". The calves averaged 369 pounds per head on October 1, 1954. It is expected they will average about 375 pounds at weaning on October 15.

#### Management of Grass

All pastures, except those involving degrees of stocking, were scheduled to be grazed at a moderate rate to provide full use without injury to the vegetation. This consisted of using  $2/3$  to  $3/4$  of the forage produced, leaving 1-inch stubble on shortgrass and 3- to 5-inch stubble on tall grass, keeping the ground surface protected with unused litter, and never grazing so heavily that the pastures presented a stomp-lot or closely grazed appearance. No special treatment, such as mowing, burning, or fertilizing, was used except in special tests. In most years, the grazing rate was carried out as planned. However, there were a few good years when all pastures were understocked, and there were several drouth years when all pastures were overstocked.





The experimental pastures were surveyed as to vegetational density in 1940, 1942, 1944, 1949, and 1951 using the statistically accurate line-transect method. These studies have been extremely helpful in evaluating grazing treatments, and will be continued. Forage production and utilization studies, conducted intensively during the last 5 years, are also used to interpret treatment effects by measuring pounds of forage produced and consumed per acre. Both temporary and permanent exclosures, to prevent cattle grazing, are established in many of the pastures and are used to help judge proper stocking rates.

### Economic Analyses

Detailed economic appraisals of all improvement practices are customarily made through cooperation of the Department of Agricultural Economics, Oklahoma A. & M. College, and the Production Economics Research Branch, ARS, USDA. These studies place a dollar value on various grazing treatments and range management practices as an aid to stockmen in improving their grazing procedures.

### RESEEDING GRASSLAND

RESEEDING poor crop land to nutritious grasses is one of the most efficient practices for increasing range production in the Southern Great Plains. Reseeded pastures on the Experimental Range yield 2 to 3 times as much beef gain per acre as adjacent native range.

The most successful method of seeding grasses is to drill, early in spring, a mixture of well-adapted perennial species into a firm seedbed protected by undisturbed stubble left by a previous crop of close-drilled sorghum. The preparatory crop is drilled about July 1 to insure maximum forage production without the sorghums maturing, volunteering, and competing with grasses later on. Grazing the sorghum crop or utilizing it as hay defrays most of the reseeding cost.

Weed competition in seedling grasses should be controlled by mowing as often as necessary to reduce heavy shading or excessive use of moisture. Two mowings are usually required during the first growing season, and one the second. However, judicious use of brief periods of heavy grazing to control weeds may reduce the mowings required.

Grass mixtures: Although pure stands of single species are planted for special studies on the Experimental Range, mixtures of the better grasses are generally recommended. Mixtures have many advantages over pure seedings, including the fact that a combination of grasses usually provides superior adaptation to variable soil and seasonal conditions, a better balanced diet, and more sustained production. Pure seedings have the advantage that valuable seed harvests can be made in years when the grass is managed properly and adequate moisture is received.

#### Suggested grass mixtures for the Southern Great Plains

| <u>Sandy land mixture</u> |                        | <u>Mixture for heavy soils</u> |                        |
|---------------------------|------------------------|--------------------------------|------------------------|
| <u>Species</u>            | <u>Pounds per acre</u> | <u>Species</u>                 | <u>Pounds per acre</u> |
| Blue grama                | 2                      | Blue grama                     | 2                      |
| Side-oats grama           | 2                      | Side-oats grama                | 2                      |
| Mixed bluestems*          | 2                      | Buffalo grass                  | 1                      |
| Western wheatgrass        | 1                      | Western wheatgrass             | 1                      |
| Switchgrass               | 1/2                    | Switchgrass                    | 1                      |
| Sand lovegrass            | 1/2                    | Yellow sweet clover            | 1                      |
| Yellow sweet clover       | 1                      |                                |                        |
| Total                     | 9                      | Total                          | 8                      |

\*Sand bluestem, little bluestem, Caucasian bluestem, King Ranch bluestem, and Indian grass.





Source of seed of native grasses merits close attention. The forage yield and length of growing season are greatly increased by using seed from southern sources. The seed may be used several hundred miles north of its source without much danger of winterkilling. Seeds of most native grasses, when grown very far south of their harvested source, produce forage decidedly lacking in vigor, production, and period of growth. A partial list of commercial sources of grass seed may be obtained upon inquiry of the Woodward Station.

### Recommended Grasses and Grazing Results

Results from a series of 50-acre reseeded pastures grazed yearlong have been recorded for 9 years. The seedings were made by the stubble-mulch method on abandoned farmland. The different grasses and grass mixtures used in these studies were rated in terms of grazing capacity, gain per head, gain per acre, and net returns in comparison with native range.

There were great differences in gains and economic returns among the various reseeded and native range pastures during the drouth year 1953-54. To illustrate, steers on King Ranch bluestem gained 329 pounds and made a net return of \$20.05 per head, whereas similar steers on a reseeded short grass mixture gained only 266 pounds and lost \$2.46 per head. In comparison with these two extremes, comparable steers on so-called moderately grazed native pastures, which were actually heavily grazed during the current year, gained 318 pounds and showed a net profit of \$11.27 per head. In general, the deep-rooted tall grasses were far superior to the short grasses. It remains to be seen, however, if the tall grasses survive and recover from the drouth and continue to yield more favorable returns than the short grasses.

| <u>Sand lovegrass and a "mixture" compared with native range</u>                                                                                                               |                                       |       |               |       |               |       |                 |       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|-------|---------------|-------|---------------|-------|-----------------|-------|
| Kind of grass                                                                                                                                                                  | 8-year average, 1946-53; and 1953-54* |       |               |       |               |       |                 |       |
|                                                                                                                                                                                | Acres per head                        |       | Gain per head |       | Gain per acre |       | Profit per acre |       |
|                                                                                                                                                                                | 8Yr.Av.                               | 53-54 | 8Yr.Av.       | 53-54 | 8Yr.Av.       | 53-54 | 8Yr.Av.         | 53-54 |
|                                                                                                                                                                                | No.                                   | No.   | Lbs.          | Lbs.  | Lbs.          | Lbs.  | \$              | \$    |
| Reseeded pastures:                                                                                                                                                             |                                       |       |               |       |               |       |                 |       |
| Sand lovegrass                                                                                                                                                                 | 3.9                                   | 3.9   | 414           | 327   | 105           | 84    | 9.66            | 4.47  |
| Mixture**                                                                                                                                                                      | 4.5                                   | 6.2   | 372           | 266   | 83            | 43    | 6.22            | -.39  |
| Native range, well managed                                                                                                                                                     | 9.2                                   | 7.5   | 380           | 318   | 41            | 42    | 3.15            | 1.50  |
| *Gains from Nov. 13, 1953 to Oct. 1, 1954.                                                                                                                                     |                                       |       |               |       |               |       |                 |       |
| **Mixture of blue grama, side-oats grama, western wheatgrass, and Texas blue-grass.                                                                                            |                                       |       |               |       |               |       |                 |       |
| ***Economics of the reseeded pastures were based on a 30-month period of establishment plus 8 years of grazing. Returns from native range were based on the entire 10.5 years. |                                       |       |               |       |               |       |                 |       |

Sand lovegrass has beef producing qualities superior to those of any other grass included in the grazing tests. Steer calves started on this grass in the fall usually doubled their weight in less than a year. These results should encourage farmers and stockmen to establish well adapted grasses on poor farmland. Results of much greater value may be expected from the use of this grass on better soils.

A mixture of blue grama, side-oats grama, western wheatgrass, and Texas blue-grass, a combination of warm-season and cool-season grasses, was superior to native range in grazing capacity, gain per acre, and net returns. This mixture has improved each year in composition. It could be further improved for sandy land by the addition of several tall grasses, including sand lovegrass, switch-grass, Indian grass, and Caucasian bluestem.





Weeping lovegrass, a high-producing introduced grass from South Africa, supported a steer on each 2 acres for a six year period, produced 139 pounds of beef per acre, and made more profit than any other pasture. It was the least palatable of the grasses however, and produced cattle with much less gain, lower grade, and usually less sales value than any other grass.

The gains of steers on weeping lovegrass were profitably increased 47 pounds by feeding 1 pound of 41 percent protein cottonseed cake daily throughout three summers. Applications of ammonium nitrate to weeping lovegrass at 30 pounds of nitrogen per acre in 1947 and 53 pounds in 1948 increased the grazing capacity 33 percent, the gain per head by a margin of 9 pounds, and the gain per acre to the extent of 37 pounds. However, the fertilized grass failed to produce gains per head comparable with those obtained from other grasses. Fertilizing and cutting the excess growth for hay, thereby keeping the regrowth more palatable, should increase the grazing value of this grass.

Steers were discontinued on this pasture in 1951 and 15 weaner heifers were started on a life-time study at that time. These heifers were handled the same as similar heifers on moderately grazed native range except for the difference in forage. The weeping love pasture was fertilized each spring with 33 pounds of nitrogen per acre. Although the cow and calf results are yet inconclusive, several points of interest stand out. The weeping lovegrass heifers weighed 96 pounds less as bred long-yearlings than similar heifers on native range. Only 47 percent of the heifers on weeping love calved the first year, in comparison with 92 percent on native range. However, the calving percentage was 90 percent on weeping love and 82 percent on native range the second year. Weaning weight of the calves from weeping love was 315 pounds the first year and 321 pounds the second, in contrast with 405 and 394 pounds on calves from native range. Calf gain per acre for the 2-year period, however, is decidedly in favor of weeping love — 102 compared with 26. To continue this paradox, the cows on weeping love have paid back \$50.97 less per head of their original investment-plus-costs than have the cows on native range. These studies will be continued until more conclusive information can be obtained.

Buffalo grass on the Experimental Range has not lived up to its famous reputation. Forage production, grazing capacity, gain per acre, and net profits have been lower than on other reseeded pastures. Gain per head has been lower than adjacent native range and less than every reseeded pasture except weeping lovegrass. However, buffalo grass exceeded native range in gain per acre.

Switchgrass, a native tall grass, was grazed as a pure stand for 6 years, fall of 1948 to fall of 1954. The grass was highly productive, yielded excellent returns per acre, and is suggested for use in mixture seedings on all soil types in this region. This grazing resistant grass is highly palatable and nutritious in summer but is somewhat lacking in both respects in winter. The grass makes excellent hay when cut before the heads appear. It usually produces satisfactory yields of clean seed that are easy to harvest and drill with ordinary machinery. It is also noted for ease of establishment and seedling vigor; it is deep-rooted and remains green and productive during severe summer drouths.





| Switchgrass compared with native range                                   |                                       |       |               |       |               |       |                   |       |
|--------------------------------------------------------------------------|---------------------------------------|-------|---------------|-------|---------------|-------|-------------------|-------|
| Kind of grass                                                            | 5-year average, 1949-53; and 1953-54* |       |               |       |               |       |                   |       |
|                                                                          | Acres per head                        |       | Gain per head |       | Gain per acre |       | Profit per acre** |       |
|                                                                          | 5-Yr.Av.                              | 53-54 | 5-Yr.Av.      | 53-54 | 5-Yr.Av.      | 53-54 | 5-Yr.Av.          | 53-54 |
|                                                                          | No.                                   | No.   | Lbs.          | Lbs.  | Lbs.          | Lbs.  | \$                | \$    |
| Switchgrass                                                              | 3.1                                   | 3.9   | 334           | 298   | 107           | 77    | 4.48              | 3.10  |
| Native range                                                             | 8.4                                   | 7.5   | 371           | 318   | 44            | 42    | 2.99              | 1.50  |
| *Gains from Nov. 13, 1953 to Oct. 1, 1954.                               |                                       |       |               |       |               |       |                   |       |
| **Includes 30-month period of establishment plus 5 years grazing results |                                       |       |               |       |               |       |                   |       |

King Ranch bluestem, a strain of Turkestan bluestem, has been grazed as a pure stand since the fall of 1949. Cattle made exceptionally high gains on this grass except one spring when it was recovering from winter injury.

Bimonthly chemical analyses of this grass throughout 1950 showed it to be extremely high in protein content that year. Similar analyses of forage from 8-year old plants were much lower in protein but equal to other bluestem species.

| King Ranch bluestem and native range                                                |                                         |       |                 |       |               |       |                    |       |
|-------------------------------------------------------------------------------------|-----------------------------------------|-------|-----------------|-------|---------------|-------|--------------------|-------|
| Kind of grass                                                                       | 4-year average, 1950-1953; and 1953-54* |       |                 |       |               |       |                    |       |
|                                                                                     | Acres per head                          |       | Gain per head** |       | Gain per acre |       | Profit per acre*** |       |
|                                                                                     | 4-Yr.Av.                                | 53-54 | 4-Yr.Av.        | 53-54 | 4-Yr.Av.      | 53-54 | 4-Yr.Av.           | 53-54 |
|                                                                                     | No.                                     | No.   | Lbs.            | Lbs.  | Lbs.          | Lbs.  | \$                 | \$    |
| King Ranch bluestem                                                                 | 3.7                                     | 3.6   | 368             | 329   | 100           | 92    | 3.30               | 5.57  |
| Native range                                                                        | 8.2                                     | 7.5   | 378             | 318   | 46            | 42    | 2.60               | 1.50  |
| *Gains from Nov. 13, 1953 to Oct. 1, 1954.                                          |                                         |       |                 |       |               |       |                    |       |
| **Steers were off pasture for 6 weeks in 1951 due to severe winter injury of grass. |                                         |       |                 |       |               |       |                    |       |
| ***Includes 30-month period of establishment plus 3 years grazing results.          |                                         |       |                 |       |               |       |                    |       |

King Ranch bluestem was severely injured by the extremely dry, cold winter of 1950-51. About 10 to 20 percent of the plants were killed, the remainder badly injured, and growth was negligible in spring of 1951. Steers had to be removed from the pasture on June 1 because of lack of forage; however, a good stand of seedlings covered the entire pasture and the injured plants recovered sufficiently so that the cattle were placed back on pasture 6 weeks later. The grass recovered completely from winter injury by 1952 when the cattle on it produced excellent gains.

King Ranch bluestem is highly productive, readily established, protects itself from grazing while very young by growing flat on the ground, and despite winter injury which may occur infrequently, it is a promising grass for the southern portion of the region. A close relative, Caucasian bluestem, appears to be better adapted to the northern part of the region. Both of these grasses are outstanding in their ability to remain green in the face of summer drouth, and to grow despite midsummer heat if moisture is available.

Western wheatgrass, a native cool-season grass which grows during cool weather in fall and spring, was profitably used to promote winter gains and save protein supplements. The 5-year average winter gain on western wheatgrass was 28 pounds per head with no cake and 74 pounds with 1 pound of cake, as compared with 57 pounds on native range with 2 pounds of cake. This grass should be included in all grass mixtures to provide a cheap source of protein, vitamin-A, and phosphorus during the critical winter period. It is not recommended that this grass be planted as a pure seeding in this region because it is invaded easily by poor quality summer-growing grasses and weeds.





Western wheatgrass has been grazed as a pure seeding in rotation with native range for 8 years. Cattle grazed annually on this grass from November 15 until the grass approached dormancy in early summer (May 15 to July 1). When the grass became coarse in June, the steers were rotated to native range. The combined results from this rotation are compared with continuously grazed native range.

| Western wheatgrass-native range rotation compared with native range |                                       |                 |                 |                 |                 |                 |
|---------------------------------------------------------------------|---------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Pasture and<br>winter feed                                          | 8-year average, 1946-53; and 1953-54* |                 |                 |                 |                 |                 |
|                                                                     | Acres per head                        |                 | Gain per head   |                 | Gain per acre   |                 |
|                                                                     | 8-Yr. Av. 53-54                       | 8-Yr. Av. 53-54 | 8-Yr. Av. 53-54 | 8-Yr. Av. 53-54 | 8-Yr. Av. 53-54 | 8-Yr. Av. 53-54 |
|                                                                     | No.                                   | No.             | Lbs.            | Lbs.            | Lbs.            | Lbs.            |
| Western wheat-native range                                          |                                       |                 |                 |                 |                 |                 |
| with 1# cake in winter                                              | 7.4                                   | 6.2             | 371             | 315             | 50              | 50              |
| Continuous native range                                             |                                       |                 |                 |                 |                 |                 |
| with 2# cake in winter                                              | 9.2                                   | 7.5             | 380             | 318             | 41              | 42              |
| *Gains from Nov. 13, 1953 to Oct. 1, 1954.                          |                                       |                 |                 |                 |                 |                 |

Texas bluegrass, a native cool-season grass adapted to sandy lands in the region, was an excellent source of protein and vitamin-A throughout the winter, and produced excellent gains without any cottonseed cake. However, seed of this grass is not available commercially, because cotton-like fibers surround and adhere to the seed, making harvest extremely difficult.

New reseeded pastures have been added to the reseeded grazing comparisons. Three of the new pastures, Marfa blue grama — a productive southern strain, common blue grama, and a reseeded tall grass mixture (sand and little bluestem, switchgrass, Indian grass, and sand lovegrass) were seeded in April 1951 and grazing was started in the fall of 1952. As shown in the table below, the tall grass mixture was the most productive with Marfa blue grama being superior to the common variety.

Two of the new pastures were seeded in early April of 1952, and grazing was commenced in November 1953. A mixture of sand lovegrass and sand dropseed made significantly greater gains than sand dropseed alone.

Two other pastures were seeded in the spring of 1952 but failed to develop satisfactory stands. These were (1) Caucasian bluestem and (2) a mixture of tall grasses and Nomad alfalfa. These pastures will be seeded again in the spring of 1955.

| New reseeded pastures compared with native range    |          |          |          |
|-----------------------------------------------------|----------|----------|----------|
| Kind of pasture                                     | Acres    | Gain     | Gain     |
|                                                     | per head | per head | per acre |
|                                                     | No.      | Lbs.     | Lbs.     |
| <u>Pastures grazed only in 1952-53 and 1953-54:</u> |          |          |          |
| Marfa blue grama                                    | 4.2      | 357      | 85       |
| Common blue grama                                   | 4.6      | 339      | 74       |
| Tall Grass Mixture                                  | 4.2      | 368      | 88       |
| Native range, moderately used                       | 8.2      | 349      | 42       |
| <u>Pastures grazed only in 1953-54:</u>             |          |          |          |
| Sand dropseed                                       | 4.2      | 353      | 85       |
| Sand love and sand drop mixture                     | 4.2      | 417      | 100      |
| Native range, moderately used                       | 7.5      | 318      | 42       |





## GRASS BREEDING INVESTIGATIONS

INFORMATION already given in this report shows that reseeded pastures are profitable investments. The grass breeding program is designed to develop grass strains which will make reseeding even more profitable. Productive strains, high in leaf percentage, with good seedling vigor, and rapid early growth are being selected. Special attention is also paid to better and more frequent seed production. Additional studies are aimed at developing pasture legumes to increase yield and forage value of reseeded grasses.

### Background

Fifteen years ago, very little was known about the breeding behavior of our native species of grass. The breeding program at Woodward was initiated by Dr. M. L. Peterson, at present head of the Department of Agronomy at the University of California, Davis, California. He was followed by Dr. J. R. Harlan, who in 1950, took charge of forage investigations of the Oklahoma Agricultural Experiment Station. Much of the procedures and material used today were developed by Dr. Harlan during the years 1942-1950, based on previous work of Dr. Peterson and earlier species comparisons made by D. A. Savage.

### Fundamental Investigations

Before grasses may be improved, something must be known about them. Much of the earlier work at Woodward was to learn the fundamental information necessary to conduct a breeding program. Studies were made of the effect of inbreeding on several species, the breeding behavior of side-oats grama, development of buffalo grass seed, type of seed formation in aberrant forms of side-oats grama, chromosome numbers in blue grama, etc. Fundamental research continues to be part of the program with such studies as sex inheritance in buffalo grass, genetics of Indian grass, and variation in switchgrass.

### Highlights of Recent Research

#### Seedling Vigor Studies

The most vigorous six-week old seedlings of two side-oats grama strains were selected from drilled rows in spring 1953. These plants were grown in isolation so they could cross only with each other. Seed taken from them produced seedlings in 1954 which were much more vigorous than those from seed of the original strains. Additional selections have been made. Side-oats grama is relatively weak in seedling vigor, and improvement of this character will be of considerable value.

For the past two years intensive greenhouse studies have been made of the relationship of seed size to seedling vigor in several native grass species. This spring a field planting was made. The results show that large seed is decidedly superior to small or average seed in time of emergence, percentage stand, and initial seedling growth. Careful studies have been made of seed size in sand bluestem. A wide range exists, indicating that breeding for larger seed size might be relatively easy. Selections with the largest seed have tended to have the best progenies, not only at the seedling stage but later as well. These studies emphasize that stockmen will profit most by using the highest quality seed that can be reasonably obtained.

#### Palatability studies with weeping lovegrass

Several introductions of weeping lovegrass from Africa were set out as spaced plants in 1953. Notes were taken that year and again in 1954 on relative toughness of leaf. This was measured by hand-pulling a few leaves from each plant.



THE HISTORY OF THE

The history of the world is a vast and complex subject, encompassing the lives of countless individuals and the events that have shaped our civilization. From the earliest times to the present day, the human story has been one of constant change and growth. The study of history allows us to understand the patterns of human behavior and the forces that have driven our progress. It is a discipline that challenges us to think critically and to seek out the truth in a world of conflicting opinions. The history of the world is not just a collection of facts and dates, but a living and breathing entity that continues to evolve and grow. It is a testament to the resilience and ingenuity of the human spirit, and a source of inspiration for all who seek to make a difference in the world.

CHAPTER I

The first chapter of the history of the world is the story of the beginning of time. It is a story that has fascinated humanity for centuries, and one that continues to captivate our imagination. The origins of life and the development of the universe are the most fundamental questions we can ask, and the answers to these questions have the potential to revolutionize our understanding of the world. The history of the world begins with the Big Bang, a cataclysmic event that created the universe as we know it. From that moment on, the universe has been expanding and evolving, and the history of the world is a record of this process. The study of the history of the world is a journey that takes us from the beginning of time to the present day, and it is a journey that is both challenging and rewarding. It is a journey that allows us to see the world in a new light, and to appreciate the incredible complexity and beauty of the universe.

CHAPTER II

The second chapter of the history of the world is the story of the early human civilizations. It is a story of the first steps towards modernity, and of the challenges that these early civilizations faced. The early human civilizations were the first to develop agriculture, writing, and other technologies that have shaped the world as we know it. These civilizations were the first to create a sense of community and to develop a shared culture. They were the first to build cities and to create a complex social structure. The study of the early human civilizations is a journey that takes us back to the roots of our species, and it is a journey that allows us to see the world in a new light. It is a journey that challenges us to think about the nature of human civilization and the forces that have driven its development. The early human civilizations were the first to create a world that was different from the one we live in today, and their story is a testament to the resilience and ingenuity of the human spirit.

CHAPTER III

The third chapter of the history of the world is the story of the classical civilizations. It is a story of the great empires of the ancient world, and of the achievements of these civilizations in art, science, and philosophy. The classical civilizations were the first to create a world that was truly global, and their influence has been felt throughout the history of the world. The classical civilizations were the first to develop a sense of history and to create a shared culture. They were the first to build cities and to create a complex social structure. The study of the classical civilizations is a journey that takes us back to the roots of our species, and it is a journey that allows us to see the world in a new light. It is a journey that challenges us to think about the nature of human civilization and the forces that have driven its development. The classical civilizations were the first to create a world that was different from the one we live in today, and their story is a testament to the resilience and ingenuity of the human spirit.

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In 1954, steers grazed the different strains on two occasions. The first grazing was of well-developed, nearly mature growth which was fairly low in palatability. Some strains including the common weeping lovegrass, which was used as a control, were virtually ungrazed. The most tender leafed lines, as previously determined by hand-pulling, were grazed to the ground. The second grazing was on rather short, succulent regrowth and the steers ate most of the forage from all strains. Little difference was noted.

These results indicate it is possible to select more palatable types of weeping love. Selection by the simple process of pulling the leaves was effective. Further studies of additional material will be made with the aim of producing a high-yielding, more palatable weeping lovegrass.

#### Forage Quality Investigations

Studies have shown that the more productive strains of side-oats grama and blue grama outyield the common strains by 50 percent or more. In addition chemical analyses have shown significant differences among varieties in protein percentage. Some of the high yielders have also been high in protein, indicating that selection can improve both yield and quality.

Studies during 1954 of sand bluestem selections and their progenies determined what percentage of the forage they produced was leaf. A study of this kind is important because grass leaves generally have twice as much protein and much less fiber than the stems. Dried forage of each selection, each progeny line, and common sand bluestem was separated into leaves and stems. The selections averaged 39 percent leaf, their progenies 39 percent, and the common checks 28 percent. Some lines were over 50 percent leaf. In addition, stems of the leafy plants were usually finer and more desirable for grazing. All samples were taken when the plants were first flowering. It is interesting to note that alfalfa separates into about 50 percent leaf.

#### Legume Studies

A planting was made in May 1954 to compare the effects of legumes on the growth of associated grasses. Several strains of "dry land alfalfas" and other legumes will be compared in terms of the yield of grasses growing adjacent to, as well as several feet from, the legume. Little or no information is available on how much nitrogen fixation legumes do in this semi-arid region.

Seed increases of three native legumes -- cat claw sensitive brier, hairy prairie clover, and Illinois bundleflower were established in 1954. An excellent stand of the bundleflower was obtained, and nearly 200 pounds of seed was harvested from a half-acre plot. Chemical analysis of the seed showed 33.9 percent protein and 11.3 percent crude fiber. Further investigations are under way as to the potentialities of this species; they appear excellent.

#### Seed Production Studies with Grasses

Studies with switchgrass have shown that application of 40 pounds of nitrogen or more per acre doubled seed yield. Split applications with part in early spring and part at boot stage seemed to be more efficient than applications of equivalent amounts of nitrogen in early spring. Additional studies are being made.

Other studies have been made on means of increasing seed production in blue grama. It was found that seed head production could be greatly increased by mowing blue grama in early summer, and then, by applying nitrogen fertilizer and water in August. Tests have also indicated that there may be extensive insect damage to blue grama seed while it is being formed. Increased seed was obtained where insects were controlled. Some possibility also exists for increasing side-oats grama seed production by using insecticides.





## BRUSH CONTROL

EXTENSIVE BRUSH CONTROL experiments conducted since 1937 have shown that three-fourths of the sand sagebrush (Artemisia filifolia) on infested sandy rangeland can be killed by one proper application of 2,4-D. Subsequent forage and beef production can be increased from 50 to 75 percent if grazing is deferred or extremely light for two successive summers after the sage is controlled. Chemical control is cheaper, faster, and usually more effective than mechanical control.

Mechanical methods for controlling sand sagebrush are effective only when used during June for 2 successive years. June is the month when the plant roots contain the least food reserves, as shown by a 5-year study of root reserves conducted in cooperation with Dr. J. E. Webster of the Oklahoma Agricultural Experiment Station. Mowers, whirlwind cutters, and brush beaters can be used satisfactorily. The cost of one operation is about \$3.00 per acre, and one machine can cut 20 to 40 acres per day.

Four "DON'TS" for mechanical control of sand sagebrush are: (1) DON'T beat, cut, or mow sage except from June 1 to July 15 -- particularly not after July 15, (2) DON'T cut part of a pasture -- treat all except high dunes, or livestock are certain to overgraze the treated portion, (3) DON'T graze the cut-over area until fall of the year of treatment, (4) DON'T fail to practice moderate grazing in the future. It cannot be over-emphasized that abusive use of cleared range will result in a poorer pasture than will abusive use of sagebrush range where the desirable forage plants are partially protected by growing brush.

Chemical control of sand sagebrush is effective only when the plants are growing actively and after they have reached full leaf. This period is from about May 1 to June 10, depending upon latitude and earliness of season. The most effective spray solution is 1 pound acid equivalent of 2,4-D in form of ester, in 3 gallons of diesel oil or in an emulsion of 2 gallons of water and 1 gallon of diesel oil. Current costs of one treatment -- and one is usually sufficient -- amounts to \$2.50 per acre, with a 10 percent discount for extensive areas.

Sand sagebrush cannot be controlled effectively by 2,4-D sprayings when April-May precipitation and temperatures are below normal and plant growth is late and slow. Adequate rainfall and good growing conditions are essential. Spraying shortly after a heavy rain is advisable.

Controlling thick stands of other brush will also increase ranch profits. Skunkbrush, perennial broomweed, and golden aster are controlled equally as well as sand sagebrush by the same chemical treatment applied at the same time. Prickly pear cactus and yucca (soapweed) are easily killed with a wetting spray of a 2 percent solution of 2,4,5-T. One quart of 2,4,5-T (concentration of 3.3 pounds per gal.) emulsified in 4 gallons water and 1 gallon diesel oil, make a 2 percent solution which is applied in April, May, or June to yucca, and in September to prickly pear at a material cost of about 1 cent per plant.

Shinnery oak has been defoliated but not eradicated by any of the many chemicals applied at Woodward. However, top kills above 90 percent have been obtained with a single spraying of 1 pound per acre of 2,4-D, 2,4,5-T, or combinations of the two chemicals. A total of 3 annual repeat sprayings have greatly increased grass growth and appear to have effectively controlled shinnery oak.

Although conclusive recommendations cannot be made for positive control of shinnery oak, the following suggestions are offered for limited trials. Spray





shinnery oak for 3 consecutive years between May 15 and June 15 with a per-acre rate of 1 pound of 2,4-D acid equivalent in form of ester (low volatile esters are most effective) in 3 to 5 gallons of diesel oil or in an emulsion of 2 to 4 gallons of water and 1 gallon of diesel oil. Follow general recommendations for sand sagebrush, as listed above.

Perennial and annual pasture weeds can be profitably controlled by spraying in early spring when they are 2 to 6 inches high with one-half pound acid equivalent of 2,4-D ester in 1 to 3 gallons of diesel oil or water-oil emulsion per acre.

#### Results of Grazing Brush Controlled Pastures

Steer gains: Duplicate pastures were mowed for sagebrush control in June 1941 and 1942, deferred during the summers of those years, and grazed in comparison with untreated pastures for 10 summers. The improved pastures carried 24 percent more cattle, increased gain per head 31 pounds, and produced 48 percent more beef per acre. Another pasture was improved by brush control and grazed yearlong in comparison with non-treated native range for 6 years. The brush-controlled pasture carried 70 percent more cattle and produced 70 percent more beef.

Forage production was materially increased by sagebrush control. Grass density increased 297 percent on the treated pastures and only 158 percent on the untreated pastures during the 10 favorable years from 1941 to 1951. Sagebrush on the treated pastures in 1951, ten years after treatment, was only 19 percent of the quantity present on the untreated pastures.

Complete eradication of sand sagebrush is possible through a combination of mechanical and chemical treatments in successive or alternate years. However, this degree of control is not desirable. About 20 percent of an average stand of sagebrush should be left on the land to provide soil protection and some browse for cattle in late winter and early spring.

#### Economics of Brush Control

Annual net returns from pastures grazed only during the summer season for 10 years were \$8.19 per acre for brush-cleared pastures and \$5.62 for non-treated comparisons. The cleared pastures in the yearlong grazing comparisons made annual net returns of \$7.70 per acre while the untreated pastures made \$4.52. Brush control increased profits \$3.18 per acre or 70 percent.

Brush-controlled pastures gave less net return per acre but more per dollar invested than did reseeded pastures on abandoned farmland. This suggests that stockmen with limited capital could well confine their initial efforts to brush control.

#### Results of Grazing Brush-Controlled-Pastures with Cows

A study was started with cows in 1951 to determine the optimum grazing rate for brush controlled range. Duplicate pastures on mowed range were grazed moderately in direct comparison with similar pastures grazed fairly heavy -- but not overgrazed. These two sets of pastures were in turn compared with duplicate untreated native range pastures, grazed moderately.

Preliminary results of the first 3 years of this study are shown below. Indications are that the cows on the moderately grazed mowed pastures will outperform those on untreated native range. The 2-year average calf gain per acre on the moderately grazed mowed range was 43 pounds in comparison with only 26 pounds on the untreated pastures.





Preliminary Summary of Cow-Calf data during the 3-year period  
fall of 1951 to fall of 1954

| Items<br>of<br>comparison                  | Treatment and Stocking Rate |                |                       |
|--------------------------------------------|-----------------------------|----------------|-----------------------|
|                                            | Mowed<br>moderate           | Mowed<br>heavy | Untreated<br>moderate |
| <u>Cow Data:</u>                           |                             |                |                       |
| Body Wt. as weaner heifers; 11-15-51       | 446                         | 448            | 454                   |
| Body Wt. as long-yearling heifers; 11-4-52 | 795                         | 770            | 778                   |
| Yearlong gain per head, 1951-52            | 349                         | 322            | 324                   |
| Acres per head; 1951-52                    | 6.3                         | 4.6            | 7.5                   |
| Gain per acre, 1951-52                     | 55                          | 70             | 43                    |
| Body Wt. near calving time; 3-1-53         | 862                         | 806            | 828                   |
| Body Wt. at weaning time; 10-6-53          | 955                         | 918            | 922                   |
| Yearlong gain per head; 1952-53            | 160                         | 148            | 144                   |
| Acres per head; 1952-53                    | 9.2                         | 6.7            | 13.3                  |
| Body Wt. near calving time; 3-1-54         | 952                         | 874            | 917                   |
| Body Wt. near weaning time; 10-1-54        | 921                         | 833            | 884                   |
| Yearlong gain per head; 1953-54            | -34                         | -35            | -38                   |
| Acres per head; 1953-54                    | 11.0                        | 8.0            | 14.5                  |
| <u>Calving Data: 1/</u>                    |                             |                |                       |
| <u>1953:</u>                               |                             |                |                       |
| No. of cows per treatment                  | 16                          | 16             | 26                    |
| No. of calves born                         | 16                          | 15             | 24                    |
| Percentage of fertile cows                 | 100                         | 94             | 92                    |
| Average calving date                       | Apr. 2                      | Apr. 4         | Apr. 5                |
| Average birth weight                       | 73                          | 68             | 68                    |
| Number of calves weaned                    | 13                          | 14             | 24                    |
| Percentage of calves weaned                | 81                          | 88             | 92                    |
| Average weaning weight (sex corrected)     | 419                         | 384            | 405                   |
| Pounds of calf weaned per cow 2/           | 419                         | 360            | 374                   |
| Pounds of calf per acre 2/                 | 51                          | 60             | 28                    |
| <u>1954:</u>                               |                             |                |                       |
| No. of cows per treatment                  | 12                          | 12             | 22                    |
| No. of calves born                         | 11                          | 10             | 18                    |
| Percentage of fertile cows                 | 92                          | 83             | 82                    |
| Average calving date                       | Mar. 20                     | Apr. 4         | Mar. 24               |
| Average birth weight                       | 77                          | 68             | 73                    |
| Number of calves weaned                    | 11                          | 10             | 18                    |
| Percentage of calves weaned                | 92                          | 83             | 82                    |
| Average weaning weight (sex corrected)     | 428                         | 361            | 394                   |
| Pounds of calf weaned per cow 2/           | 392                         | 301            | 322                   |
| Pounds of calf per acre 2/                 | 36                          | 38             | 22                    |
| <u>SUMMARY:</u>                            |                             |                |                       |
| Gain per cow; 11-15-51 to 10-1-54          | 475                         | 385            | 430                   |
| Average weight of cows; 10-1-54            | 921                         | 833            | 884                   |
| Pounds of calf per cow (2-years) 2/        | 408                         | 335            | 350                   |
| Pounds of calf per acre (2-years) 2/       | 43                          | 49             | 26                    |

1/ Based only on cows that raised calves in the year reported upon.

2/ Based on fertile cows.





GRAZING MANAGEMENT

OVERUSE and underuse of range forage reduces beef production and ranch profits. Maximum returns can be secured only by proper management of livestock, the market-able product, and by optimum use of grass, the raw resource. Proper use of range can be defined as that which will produce the greatest sustained monetary return per ranch unit, or full use without abuse.

Continuous Yearlong Grazing for 10 Years with Steers

Continuous yearlong grazing of native range was tested in duplicate pastures at heavy, moderate, and light rates of stocking during the 10-year period 1941-50. Average dates of grazing were from November 9 of one year to October 6 of the following year. An average of 16 steers per pasture or 32 per treatment were used each year. Differential grazing rates were obtained by allowing 107 acres per pasture for heavy use, 160 acres for moderate use, and 213 acres for light use.

Vegetation improved greatly under all degrees of use for the first 10-year period. Grass density increased 145 percent under heavy use, 67 percent under moderate use, and 81 percent under light use. Grazing-resistant blue grama and buffalo grass, and the short-lived grasses, such as fall witchgrass, sand paspalum, and sand dropseed, increased most under heavy grazing. The productive tall grasses, including sand lovegrass, sand bluestem, little bluestem, and switchgrass, decreased under heavy use from 13 percent of all grass in 1940 to only 9 percent in 1949. They increased from 13 to 22 percent under moderate use and improved from 11 to 17 percent under light use. Despite these results, it seems evident that the "heavy" rate of grazing used in these studies did not represent overgrazing during the first 10 years.

Steer gains: Heavy grazing produced annual averages of 23 pounds less gain per steer and 16 pounds more beef per acre than the moderate rate. Similar comparisons of heavy with light grazing showed 39 pounds less gain per head and 25 pounds more gain per acre for the heavy rate.

| Ten-year comparisons of degrees of continuous yearlong grazing of native range |                      |                        |              |             |                       |             |               |             |
|--------------------------------------------------------------------------------|----------------------|------------------------|--------------|-------------|-----------------------|-------------|---------------|-------------|
| Rate<br>of<br>grazing                                                          | <u>Stocking rate</u> |                        | <u>Steer</u> |             | <u>Advantage over</u> |             | <u>Av.</u>    |             |
|                                                                                | Acres<br>per<br>head | Head<br>per<br>section | <u>gain</u>  |             | <u>heavy use in</u>   |             | <u>profit</u> |             |
|                                                                                |                      |                        | Per<br>head  | Per<br>acre | Head<br>gain per      | Acre        | Per<br>head   | Per<br>acre |
|                                                                                | <u>No.</u>           | <u>No.</u>             | <u>Lbs.</u>  | <u>Lbs.</u> | <u>Lbs.</u>           | <u>Lbs.</u> | <u>\$</u>     | <u>\$</u>   |
| Heavy                                                                          | 6.5                  | 98                     | 361          | 56          |                       |             | 40.89         | 6.46        |
| Moderate                                                                       | 9.7                  | 66                     | 384          | 40          | 23                    | -16         | 42.86         | 4.52        |
| Light                                                                          | 12.9                 | 50                     | 400          | 31          | 39                    | -25         | 42.10         | 3.36        |

Yearlong Grazing after 10 Years of Summer Use

After 10 years of grazing use only in summer, a group of the experimental pastures were changed to a yearlong grazing program in the fall of 1951. Yearling steers had been used on the pastures each summer. Thereafter, weaner steers were started on the pastures each fall; these animals were handled similarly to other calves used in yearlong studies during the previous ten years. The following table gives previous and present pasture treatment together with yearlong stocking rates and gains. The heavily grazed pastures showed low gains and a net monetary loss in the current drouth year.

CHAPTER 1

The first part of the book is devoted to a general introduction to the subject. It discusses the importance of the study and the scope of the work. The author also mentions the sources of the material and the method of the investigation.

SECTION 1.1

In this section, the author discusses the basic principles of the theory. He starts with a definition of the terms and then proceeds to a detailed explanation of the concepts. The author also mentions the historical development of the theory and the contributions of the various scientists.

The next part of the section is devoted to a discussion of the experimental results. The author describes the apparatus used and the method of the experiment. He then presents the data and discusses the results. The author also mentions the limitations of the experiment and the need for further research.

In the final part of the section, the author discusses the conclusions of the study. He summarizes the main findings and discusses their implications. He also mentions the need for further research and the possibility of future work.

| TABLE 1.1 |     |
|-----------|-----|
| 1         | 2   |
| 3         | 4   |
| 5         | 6   |
| 7         | 8   |
| 9         | 10  |
| 11        | 12  |
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| 81        | 82  |
| 83        | 84  |
| 85        | 86  |
| 87        | 88  |
| 89        | 90  |
| 91        | 92  |
| 93        | 94  |
| 95        | 96  |
| 97        | 98  |
| 99        | 100 |

SECTION 1.2

In this section, the author discusses the theoretical aspects of the study. He starts with a discussion of the basic principles and then proceeds to a detailed explanation of the concepts. The author also mentions the historical development of the theory and the contributions of the various scientists.



Comparison of several yearlong grazing systems following 10 years of differential grazing use in summer.

| Previous<br>10-year<br>summer<br>treatment | Present<br>yearlong<br>grazing<br>treatment | 3-year average, 1952-54 |             |             | Profit in<br>1953-54 |             |
|--------------------------------------------|---------------------------------------------|-------------------------|-------------|-------------|----------------------|-------------|
|                                            |                                             | Acres                   | Gain        |             |                      |             |
|                                            |                                             | per<br>head             | Per<br>head | Per<br>acre | Per<br>head          | Per<br>acre |
|                                            |                                             | No.                     | Lbs.        | Lbs.        | \$                   | \$          |
| Moderate                                   | Moderate                                    | 7.7                     | 346         | 45          | 11.27                | 1.50        |
| Heavy                                      | Heavy                                       | 5.2                     | 253         | 49          | -10.93               | -2.19       |
| Mod-rotation                               | Moderate                                    | 8.0                     | 355         | 45          | ---                  | ---         |
| Hvy-rotation                               | Heavy                                       | 5.2                     | 280         | 54          | ---                  | ---         |
| Mowed-mod.                                 | Mowed-mod.                                  | 7.2                     | 354         | 49          | ---                  | ---         |

Yearlong Grazing with Cows

In 1951, a cow herd was started on these pastures to measure effects of grazing treatments with cows and calves instead of with steers. Insufficient data has been obtained with cows to draw more than preliminary conclusions. Two indications may be worthy of mention, however. It appears the beef gain per acre is going to be appreciably smaller with cows than with steers -- only about 60 percent as much. It also appears that heavy grazing with cows and calves is more detrimental to the animals than the same degree of use with steers. Preliminary results of the first three years data with cows and calves is given in the following table.

Effects of the current drouth upon the vegetation were particularly evident by July 1, 1953. The grass in the overgrazed pastures was grazed closer on that date than at any time in any previous year. By October 1954, no annual weeds were to be found in these pastures. All had been eaten. Blue grama was grazed to a stubble height of not more than 1/2". Little bluestem was uniformly cropped off at 1" and only a few of the other tall grasses could be observed from horseback. Close examination of the ground showed some plants of all species killed back to ground level and extremely difficult to find. Sagebrush was a substantial part of the cows diet throughout the winter of 1953-54, and all during the summer of 1954.

The aspect of the moderately grazed pastures on October 1, 1954, was quite different from that in the heavily grazed pastures. However, the moderately grazed pastures were much too heavily grazed at that time to finish the winter season in April 1955 at anything approaching a moderate rate. A few annual weeds were still in evidence. Blue grama was uniformly cropped nearly as close as in heavily grazed pastures and at least 80 percent of the little bluestem plants were grazed to a stubble height of about 1-1/2". Most of the forage eaten by the cattle this year has been little bluestem.

The lightly grazed pastures were much like the moderate pastures with the one exception that occasionally areas of little bluestem were not heavily utilized. Such areas were rather rare, however. Large clumps of sand bluestem, switchgrass and Indian grass which had not been grazed off in 1952 and 1953 were 90 percent dead. However, a nucleus of green growth remained in most of the clumps.





Preliminary Summary of Cow-Calf Data during the 3-year period,  
Fall of 1951 to Fall of 1954

| Items of<br>comparison                         | Stocking Rate |          |         | Native Range<br>Rotation |
|------------------------------------------------|---------------|----------|---------|--------------------------|
|                                                | Heavy         | Moderate | Light   |                          |
| <u>Cow Data:</u>                               |               |          |         |                          |
| Body wt. as weaner heifers; 11-15-51           | 454           | 454      | 452     | 454                      |
| Body wt. as long-yearling heifers;<br>11-4-52  | 689           | 778      | 806     | 719                      |
| Yearlong gain per head, 1951-52                | 235           | 324      | 354     | 265                      |
| Acres per head; 1951-52                        | 5.0           | 7.5      | 10.0    | 7.5                      |
| Gain per acre, 1951-52                         | 47            | 43       | 35      | 35                       |
| Body wt. at calving time; 3-1-53               | 729           | 828      | 874     | 800                      |
| Body wt. when calves were weaned; 10-6-53      | 824           | 922      | 948     | 903                      |
| Yearlong gain per head; 1952-53                | 135           | 144      | 142     | 184                      |
| Acres per head; 1952-53                        | 8.9           | 13.3     | 17.5    | 13.3                     |
| Body wt. near calving time; 3-1-54             | 829           | 917      | 947     | 913                      |
| Body wt. when calves were weaned; 10-1-54      | 782           | 884      | 918     | 856                      |
| Yearlong gain per head, 1953-54                | -42           | -38      | -30     | -47                      |
| Acres per head; 1953-54                        | 9.7           | 14.5     | 19.4    | 14.5                     |
| <u>Calving Data:</u>                           |               |          |         |                          |
| <u>1953:</u>                                   |               |          |         |                          |
| No. of cows per treatment                      | 26            | 26       | 26      | 13                       |
| No. of calves born                             | 25            | 24       | 25      | 11                       |
| Percentage of fertile cows                     | 96            | 92       | 96      | 85                       |
| Average calving date                           | Apr. 3        | Apr. 5   | Apr. 8  | Apr. 10                  |
| Average birth weight                           | 63            | 68       | 70      | 69                       |
| Number of calves weaned                        | 25            | 24       | 25      | 11                       |
| Percentage of calves weaned                    | 96            | 92       | 96      | 85                       |
| Average weaning wt. (sex corrected)            | 328           | 405      | 424     | 367                      |
| Pounds of calf weaned per cow                  | 315           | 374      | 408     | 310                      |
| Pounds of calf per acre                        | 35            | 28       | 23      | 23                       |
| <u>1954:</u>                                   |               |          |         |                          |
| No. of cows per treatment                      | 22            | 22       | 22      | 11                       |
| No. of calves born                             | 15            | 18       | 18      | 11                       |
| Percentage of fertile cows                     | 68            | 82       | 82      | 100                      |
| Average calving date                           | Apr. 22       | Mar. 24  | Mar. 17 | Apr. 6                   |
| Average birth weight                           | 68            | 73       | 77      | 71                       |
| No. of calves weaned                           | 15            | 18       | 17      | 11                       |
| Percentage of calves weaned                    | 68            | 82       | 77      | 100                      |
| Av. weaning weight (sex corrected)             | 286           | 394      | 436     | 343                      |
| Pounds of calf weaned per cow <sup>1/</sup>    | 195           | 322      | 357     | 343                      |
| Pounds of calf per acre                        | 20            | 22       | 18      | 24                       |
| <u>SUMMARY:</u>                                |               |          |         |                          |
| Gain per cow, 11-15-51 to 10-1-54              | 328           | 430      | 466     | 402                      |
| Av. weight of cows, 10-1-54                    | 782           | 884      | 918     | 856                      |
| Pounds of calf per cow (2-years) <sup>1/</sup> | 260           | 350      | 384     | 325                      |
| Pounds of calf per acre (2-years)              | 29            | 26       | 21      | 24                       |

<sup>1/</sup> Based on fertile cows.





### Continuous Summer Grazing

Continuous grazing of sandy native range during the summer 6 months was compared in duplicate pastures at heavy and moderate rates for a 10-year period. The average grazing season extended from April 15 to October 6. An average of 12 yearling steers per pasture or 24 per treatment were used each year. Differential grazing rates were obtained by allowing 50 acres for heavy use and 75 acres for moderate use.

The objectives of the study were to determine proper use of range grazed only in summer and to compare summer use with yearlong use. Overgrazing, or abusive use of forage, occurred at the heavy rate, while improvement of the more productive forage species resulted from moderate use. Detrimental effects of heavy use on steer gain, vegetation, and soil were more apparent in these studies than in pastures grazed yearlong. However, the heavy rate returned the greatest profits.

Steer gains: Heavy grazing produced 39 pounds less gain per steer and 14 pounds more beef per acre than moderate use as an average of 10 years.

#### Ten-year comparison of heavy and moderate stocking rates on native range grazed continuously throughout the summer

| Period and<br>rate<br>of<br>grazing | Stocking rate |                | Steer<br>gain |             | Advantage over<br>heavy use in |      | Av.<br>profit |             |
|-------------------------------------|---------------|----------------|---------------|-------------|--------------------------------|------|---------------|-------------|
|                                     | Acres         | Head           |               |             | heavy use in                   |      |               |             |
|                                     | per<br>head   | per<br>section | Per<br>head   | Per<br>acre | Head                           | Acre | Per<br>head   | Per<br>Acre |
|                                     | No.           | No.            | Lbs.          | Lbs.        | Lbs.                           | Lbs. | \$            | \$          |
| Heavy                               | 4.2           | 152            | 262           | 62          |                                |      | 28.34         | 7.02        |
| Moderate                            | 6.2           | 103            | 301           | 49          | 39                             | -13  | 34.70         | 5.81        |

Vegetation was overgrazed under the heavy rate of stocking. Invader-type grasses, including fall witchgrass, sand paspalum, blue lovegrass, and hairy grama, increased 7-fold under heavy use and the productive tall grasses decreased both in actual density and percentage composition. Vigor of the grasses was much lower in the overgrazed pastures in 1951 than in those moderately grazed. This was particularly evident in the case of blue grama. Sand sagebrush increased 146 percent under heavy use and 107 percent under moderate. It was badly broken apart under heavy use, indicating that the steers were forced to search for forage growing within the protection of brush.

Despite the abuse which has occurred under heavy use, the vegetation and soil did not suffer irreparable damage. Sagebrush control combined with deferment of grazing for 2 successively favorable growing seasons would greatly increase the few remaining tall grasses and subsequent forage productivity, as evidenced by other results.

Yearlong vs. summer grazing: Continuous yearlong grazing represents a conservation practice in this region, since enough forage must be left on the land at the end of the growing season to carry livestock throughout winter. This results in less injury to vegetation than where pastures are grazed to utilize most forage during summer.

### Rotation Grazing

Continuous summer grazing was compared with 3-division rotation grazing in duplicate pastures at both heavy and moderate stocking rates for a 10-year period. These pastures contained the same acreage and were stocked and handled exactly as





were those in the continuous summer grazing studies with one exception. The rotation pastures were divided into 3 equal parts and the steers rotated among divisions at regular intervals. They were rotated at 2-month intervals in 1942 and at 1-month or shorter intervals each year thereafter.

Steer gains: Rotation grazing at 2-month intervals in 1942 reduced steer gains 65 pounds per head at the heavy rate and 37 pounds at the moderate rate. There was no real difference between gains in later years.

Vegetation changes: Density of blue grama increased significantly from 1940 to 1951 in the heavily grazed rotations. The tall grasses, such as sand bluestem, little bluestem, sand lovegrass, and switchgrass, increased most under rotation at both grazing rates, while sand dropseed decreased slightly in density only under rotation grazing. The perennial forbs, most of which are readily eaten by steers, decreased 50 to 67 percent under moderate and heavy continuous use, respectively, and increased 20 and 33 percent under rotation at the respective stocking rates. The invader-type grasses, including sand paspalum, fall witchgrass, and hairy grama, increased most under continuous use which indicated that rotation grazing was slightly beneficial.

Economics: Net profits from the two systems of grazing years were essentially the same. Both systems of grazing at the heavy rate made a net annual profit of \$5.85 per acre. Rotation grazing at the moderate rate made an annual profit of \$4.49 per acre, whereas, continuous grazing at the moderate rate made \$4.39 annually. These analyses included an extra charge for fencing the rotations but not for additional labor or watering facilities.

Continuous and rotation grazing were not greatly different in respect to steer gains, effects on vegetation or economic returns. Therefore, this type of rotation grazing cannot be recommended over continuous grazing as an improved management practice on the sand sagebrush ranges of the Southern Great Plains.

Deferred grazing: Results from resting grass are quite different from the rotation system previously discussed. Spring or summer-long deferment of grass is an extremely beneficial range improvement practice so long as the stocking rate on an entire ranch unit is reduced or extra feed provided so that overgrazing does not occur simultaneously on another pasture. Whenever possible, spring or summer-long deferment should be combined with brush control to eliminate both grazing pressure and brush competition. In this manner, stockmen can greatly improve the over-all production of their range and carry more livestock later.

A yearlong rotation with cows and calves: Cows and calves are being used to measure effects of a 2-division rotation in direct comparison with continuous year-long use. Cattle in the rotation pastures are allowed use of the full acreage whenever the grass is dormant -- as in winter or severe drouth. They are confined into one-half of the pasture from about May 1 to June 10. They are then placed into the rested half for either the remainder of the summer, if growth is good, or for about 6 weeks when they are again given free run of the entire acreage if summer drouth conditions prevail. No definite conclusion can yet be drawn as to effects of the treatment on either cattle or grass. Preliminary data is presented in the table on page 16.

#### Discussion of Grazing Management

Proper use represents a stocking rate, grazing system, and class of livestock which will produce the greatest total volume of forage, and livestock gain, on a continuous basis. Forage plants survive by manufacturing food in green leaves. This plant food is necessary to produce more leafage and vigorous roots which will enable the plants to provide forage and withstand drouth periods. Therefore, green leaves cannot be grazed off completely at any time without serious injury to the





plant. It has been stated that no more than 50 to 75 percent of total annual forage can be utilized by livestock without plant injury. However, the 10-year investigations at Woodward indicate that three-fourths of the total forage can be utilized on a year-long basis without injury to the vegetation.

Several guides are suggested for use in determining when a range is properly grazed. A stubble height of at least 1 inch should be left on short grasses. Mid-grasses should have a minimum stubble height of at least 2 inches at the close of the grazing season; tall grasses, 3 to 5 inches. Short grass ranges are properly grazed when they first assume a uniform mowed aspect (further use is over-use).<sup>\*</sup> Ten to 20 percent of seedstocks of better grasses should be left unused. There should be no evidence of small new gullies or sheet erosion which causes hummocking of individual grass clumps. Animals should not be forced to eat large quantities of coarse or unpalatable forage. Brush should not be badly broken apart by grazing animals searching for forage. The area should not present a stomp-lot appearance with manure piles in close proximity to each other. The symptoms of over-use on sand sagebrush ranges are first discernible on dune slopes. The desirable grasses disappear and are replaced by sand dropseed, sand paspalum, fall witchgrass, sand sedge, and poor annuals, such as sand bur and purple sand grass.

Estimated yearlong stocking rates: The investigations indicate that an average of 9 acres per yearling steer is a proper "maintenance" stocking rate for yearlong grazing of sage-covered sandy range in good condition. During years of favorable precipitation and forage production, rates as low as 6 acres per yearling steer are proper. Contrarily, during poor years as much as 12 acres are needed. Range in excellent vegetative condition has one-third to one-half greater carrying capacity. "Improvement" rates of stocking, those which improve ranges in fair condition, require about 25 percent more acres than the maintenance rates needed to keep a range in good condition. Ranges in poor condition should be deferred during a summer or grazed at an improvement rate at least 50 percent less than that required for maintenance of the vegetation.

Proper stocking rates vary as much as 100 percent between good and poor years. Adjustments in stocking rate must be made to meet these changing conditions of growth. The system many stockmen are beginning to use widely is to stock breeding cows at the dry-year rate and harvest excess forage when it is available with yearling steers carried over from the previous year. This maintains the cow herd as a basic unit which need never be liquidated, and enables stockmen to reap excess forage in favorable seasons.

Distribution of grazing: It is significant that the comparatively small pastures used in these studies have not been grazed uniformly. Grazing use in all pastures was much less apparent one-half mile from water than near water. This indicates that even in small pastures proper distribution of grazing is exceedingly important. Stockmen should continually strive to obtain uniform use of their forage resource.

This can be accomplished by several methods. Watering places, including stock dams, springs, and windmills, should be developed to the greatest possible extent. Salt also promotes uniform use when placed away from water in little-used portions of the range. It should be moved to a new location each year. Extremely desirable forage types such as meadows or sub-irrigated areas may need to be fenced and grazed separately. Short drift fences can be advantageously used on many ranches to deflect animals into undergrazed areas. Frequent riding to distribute cattle is

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<sup>\*</sup>This short grass principle was developed by the U. S. Forest Service at the Central Plains Experimental range near Nunn, Colorado.





also effective. Self-feeding of salt-meal mixtures away from water may also be used to distribute grazing.

Special vegetational studies, which provide a basis for the findings presented in this and other chapters, include (1) density and botanical composition of the vegetation, (2) forage production and utilization, (3) systematic and continuous observations of cattle grazing habits and palatability preferences, (4) root reserves in grasses under different systems and intensities of grazing and for different ages of stands, (5) soil moisture determinations in relation to kinds of grass and vegetational sites, (6) chemical analyses of range forage, and (7) numerous cultural studies in respect to pasture establishment.

A 5-year study of forage production and utilization has been conducted in a moderately grazed yearlong pasture. Production varied from 2070 pounds of air-dry forage per acre in 1950 to only 760 pounds in 1954. Surprisingly, the same big variation existed in forage utilization per acre; 1041 pounds in 1950 and 430 pounds in 1954. This is surprising in that stocking rate alone could not have caused the difference. The cattle ate more in the good years than they did in the poor years.

An interesting comparison of forage production and utilization in 1953 and 1954 from pastures grazed heavily, moderately, and lightly during the past 13 years is shown in the following table. It is hoped that more data of this nature will help to explain grazing results which in some cases, are rather conflicting with present theories of good grazing management.

| Pounds of Air-Dry Forage per Acre |               |      |                  |      |               |      |
|-----------------------------------|---------------|------|------------------|------|---------------|------|
| Item                              | Heavy grazing |      | Moderate grazing |      | Light grazing |      |
|                                   | 1953          | 1954 | 1953             | 1954 | 1953          | 1954 |
|                                   | Lbs.          | Lbs. | Lbs.             | Lbs. | Lbs.          | Lbs. |
| Production                        | 970           | 540  | 1140             | 670  | 1010          | 760  |
| Utilization                       | 460           | 370  | 530              | 370  | 280           | 330  |

Forage production and utilization figures were obtained from each of the reseeded pastures during 1954. As expected, there was a close correlation between pounds of forage produced and beef production per acre. Additional data of this type promises to be of great help in evaluating pasture grasses.

| Forage Production and Utilization in 1954 compared to Steer Gains |                       |                          |             |                      |            |
|-------------------------------------------------------------------|-----------------------|--------------------------|-------------|----------------------|------------|
| Pasture No.                                                       | Kind of grass         | Oven-dry Forage per Acre |             | Yearlong Steer Gains |            |
|                                                                   |                       | Production               | Utilization | Per Head             | Per Acre   |
| <u>Reseeded Pastures:</u>                                         |                       | <u>Lbs.</u>              | <u>Lbs.</u> | <u>No.</u>           | <u>No.</u> |
| 1w                                                                | Sand dropseed         | 1240                     | 670         | 353                  | 85         |
| 1e                                                                | Sand love & sand drop | 1980                     | 1010        | 417                  | 100        |
| 2                                                                 | Marfa blue grama      | 980                      | 670         | 357                  | 85         |
| 3                                                                 | Common blue grama     | 820                      | 470         | 339                  | 74         |
| 4                                                                 | Tall grass mixture    | 980                      | 650         | 368                  | 88         |
| 6                                                                 | Switchgrass           | 1260                     | 620         | 298                  | 77         |
| 7                                                                 | Sand lovegrass        | 1170                     | 700         | 327                  | 84         |
| 8                                                                 | Weeping lovegrass     | 1350                     | 870         | ---                  | ---        |
| 9                                                                 | Short grass mixture   | 780                      | 360         | 266                  | 43         |
| 11w                                                               | Western wheatgrass    | 1090                     | 450         | 315                  | 50         |
| 12                                                                | Texas bluegrass       | 1020                     | 420         | 299                  | 36         |
| 14                                                                | King Ranch bluestem   | 1410                     | 500         | 329                  | 92         |
| <u>Native Range: (moderately grazed)</u>                          |                       |                          |             |                      |            |
| 19                                                                | Brush covered         | 760                      | 330         | 318                  | 42         |





## SUPPLEMENTAL FEEDING

Feeding trials have been conducted with Hereford steers on native range since 1944 and with breeding cows since 1951. Objectives of the studies have been to determine what kind and quantity of supplements are needed, when they are required, and how they should be fed, in order to answer current Southern Great Plains problems. Supplemental feeding of cattle on native range with various types of concentrates is being studied in relation to the best known range improvement techniques. This work has been guided by the results of comprehensive analyses of the range forage, supplemental feeds, and animal bloods conducted through the cooperation of V. G. Heller of the Department of Agricultural Chemistry Research, Oklahoma A. & M. College.

Results of these analytical investigations showed that native grasses of this area contained ample supplies of protein, phosphorus, calcium, carotene, and other food constituents for rapid growth and fattening of beef cattle from mid-April through June. No supplements other than salt were required. Protein in the range forage fell to 5 percent when the grasses dried up in mid-summer and continued to decline slightly through winter, indicating a need for protein supplements whenever the grass is dormant. Phosphorus content of the grasses exceeded the minimum requirements of beef cattle during the growing season, April to October. Most of the grasses showed slight deficiencies in phosphorus during winter but this was largely overcome in steers by feeding cottonseed cake which contains considerable phosphorus.

The calcium content of the range forage was greatly in excess of cattle requirements at all times in the year.

The carotene or provitamin-A content of the grasses was sufficient for cattle needs during the growing season, although it occasionally fell below minimum requirements in winter or during prolonged drouth. However, carotene deficiencies rarely occur on sandy land in this region. Some green forage, high in carotene, is usually available on sandy ranges throughout the year.

Data presented for the following studies is based on long-time results with steers. Since the cow and calf data is yet meager and inconclusive only a preliminary summary table of results is shown. Present indications with cows seems to corroborate that obtained with steers.

### Winter Caking Rates

During each of the past 7 winters, a 10-head lot of weaner steer calves was fed a daily ration of 1 pound of 41 percent protein cottonseed cake, in direct comparison with another lot which received 2 pounds. The steers received an average of 127 pounds of cake per head at the low rate and 254 pounds at the high rate. Steers on these 2 rates of caking were compared with another lot which received no protein supplement during 3 winters.

Steer gains during the 7-year period at the 1-pound winter caking rate were 36 pounds less in winter, 18 more in summer, or 18 less yearlong than for the 2-pound rate. The steers which wintered without any cottonseed cake in previous trials lost 46 pounds per head for the 3-winter average, gained 287 during summer, or 241 for the year. Their yearlong gain was 72 pounds per head less than the cattle fed 1 pound of cake in winter, indicating that at least 1 pound of protein supplement is needed in winter for normal growth and development of weaner calves on native range. The one-pound rate was most profitable on a yearlong basis in these tests; however, a heavier rate might be advantageous during winters of extreme feed shortage or severe weather.





### Rates of winter caking

| Daily rate | Gain per head     |             |             |                   |             |             |
|------------|-------------------|-------------|-------------|-------------------|-------------|-------------|
|            | 7-Year Average 1/ |             |             | 3-Year Average 2/ |             |             |
|            | Winter            | Summer      | Yearlong    | Winter            | Summer      | Yearlong    |
|            | <u>Lbs.</u>       | <u>Lbs.</u> | <u>Lbs.</u> | <u>Lbs.</u>       | <u>Lbs.</u> | <u>Lbs.</u> |
| 2# cake    | 78                | 250         | 328         | 69                | 249         | 318         |
| 1# cake    | 42                | 268         | 310         | 26                | 273         | 299         |
| No cake    |                   |             |             | -46               | 287         | 241         |

#### Profit above no cake

1# cake per day

\$11.05

2# cake per day

\$11.45

#### Profit above 1# cake

2# cake per day

\$-1.02

1/ 7-year period 1947-48 through 1953-54.

2/ 1948-49, 1949-50, and 1950-51.

Economic returns with steer and cottonseed cake prices as variable factors indicated a profit of \$1.02 per steer on a yearlong basis over the 7-year period in favor of the 1 pound rate of feeding, over the commonly accepted 2-pound daily feed. This difference is based on an average of 5 profitable years for the 1 pound rate and 2 profitable years for the 2-pound rate of feeding. However, a profit of \$4.07 per steer would have been made had the steers been sold at the end of the winter season. All research results obtained to date indicate weaner calves wintered on native range require at least one pound of cottonseed cake or an equivalent supplement per head per day.

### Late Summer Caking

Profitable increases in summer gains were obtained in 6 out of 8 years by feeding a protein supplement in late summer. No advantages were obtained in years when grass was green all summer. Yearling steers were moderately grazed on brush-covered native range and fed a daily ration of 1 pound of 41 percent protein cottonseed cake starting July 1 and ending October 6. A direct comparison was made between these steers and a similar lot grazed the same but fed no supplement. During the 8-year period, steers fed 1 pound of cake in late summer averaged 24 pounds more gain per head than steers not fed any cake. This included the 2 summers when the grass was green, high in protein, and required no supplement all summer. The other 6 years showed an average advantage of 30 pounds gain and \$2.20 profit per head for the 1-pound rate of caking.

Feeding 2 pounds of cake in late summer was compared with the 1-pound rate and with no cake during a 2-year trial. The 2-pound rate of feeding increased steer gains 23 pounds per head the first year and 11 pounds the second, when compared with the 1-pound rate. The heavy feeding rate was profitable in 1 out of 2 years.

### Cake Compared with Cake and Grain

A daily ration of 2 pounds of 41 percent protein cottonseed cake has been compared with a mixture of 1 pound of the same cake and 1 pound of rolled milo grain during 4 winters. The steers which received 2 pounds of cake averaged 30





pounds more gain in winter, 14 less in summer, or 16 more for the year than was obtained from the cake-grain ration. Net profits from the 2 pounds of cake exceeded those from the cake-grain combination by a margin of \$5.16 per steer in winter and \$1.18 yearlong. Although 2 pounds of cake was more profitable than the cake-grain ration in this study, it was not so profitable as 1 pound of cake alone.

#### Comparison of 41% and 20% Protein Feeds

During 3 winters yearling steers were fed a daily ration of 2 pounds of 41 percent protein cottonseed cake in direct comparison with others that received 2 pounds of 20 percent protein supplement. The two lots were then grazed together without supplements during summer. Steers fed the high-protein cake in winter outgained those fed the low protein supplement by a margin of 14 pounds in winter, 2 pounds in summer, and 16 pounds yearlong. This was not a great difference, and the practical conclusion is that the lowest cost feed on a protein basis is most advantageous.

#### Solvent and Hydraulic-processed Cottonseed Cake

Cottonseed cake made by the solvent method of extraction was compared with the standard hydraulic-extracted material as supplements for beef cattle on native range during the winters of 1945-46 and 1946-47. Both products contained about 41 percent protein but the extra oil removed by the solvent process for other uses left the solvent product containing much less fat. Despite this difference in energy value, the two supplements produced essentially the same rate of gain. It may be concluded that the two products have nearly the same feed value for beef cattle on native range in this region.

#### Soybean vs. Cottonseed Cake

Direct comparisons were made the past 3 years on the relative range feeding value of 41 percent protein soybean cake and 41 percent protein cottonseed cake. Average results to date show no real advantage for either feed. Average gains on soybean have been 10 pounds more than on cottonseed in winter, the same in summer, and 10 pounds greater on a yearlong basis. Soybean meal or cake is eaten with relish by cattle and any choice between the two protein supplements, based on present information, would depend upon differences in the ranch-delivered costs.

#### Guar Beans as a Winter Range Supplement

Preliminary results with ground or rolled guar beans as shown in the following table indicate that the beans from this annual legume (pronounced g w ä r) compare very favorably with cottonseed and soybean pellets as a protein supplement for weaner calves on winter pasture. A daily ration of 3.5 pounds of rolled guar beans per weaner steer produced slightly greater winter gains per head and more "bloom" than a standard daily steer ration of 2 pounds of 41 percent cottonseed or soybean pellets.

Summer and yearlong gains were slightly higher for guar fed steers than for those fed either cottonseed or soybean. It is planned to add another guar lot in the 1954-55 tests, which will be fed only 2 pounds per head daily. This will be on a comparable cost basis with cottonseed since the price of guar beans is quite similar to that of 41 percent cottonseed pellets.





Guar Beans Compared with Cottonseed and Soybean Cake

| Daily winter ration on native range | Gains per steer, 1953-54 |        |          |
|-------------------------------------|--------------------------|--------|----------|
|                                     | Winter                   | Summer | Yearlong |
|                                     | Lbs.                     | Lbs.   | Lbs.     |
| 2# 41% cottonseed pellets           | 117                      | 180    | 297      |
| 3½# Guar 1/                         | 134                      | 184    | 318      |
| 2# soybean pellets                  | 123                      | 192    | 315      |

1/ Approximately 25% protein -- rolled for feeding.

Guar (*Cyamopsis tetragonoloba*) is a summer-growing, drouth-resistant, annual, legume. It was introduced to this country from India in 1903 by the U. S. Department of Agriculture, but it did not arouse public interest until after 1940.

Guar is now being grown as a cash and soil improvement crop on a limited commercial scale in Texas and Oklahoma. It is generally adapted to sandy soils in the cotton and sorghum areas west of the 35-inch rainfall line and south of the 38th parallel. It should be grown as a row crop, with inoculation, phosphate fertilization, and clean cultivation. It matures in about 125 days -- the same as many sorghums.

This new legume has two uses at present, and it promises to have a third. It can be grown in rotation with crops as a soil-building legume; or the beans can be easily harvested as a cash crop for use by industry for the production of a vegetable gum. It is not an oil crop. Its third use promises to be that of a home-grown protein supplement for cattle. The need to determine this information prompted the present investigation.

Several samples of the guar beans were analyzed chemically by both General Mills and the Agricultural Chemistry Research Department of Oklahoma A. & M. College, with the results tabulated below:

| Chemical analyses of two lots of guar beans fed at Woodward in 1953-54 |          |     |         |     |       |      |     |     |
|------------------------------------------------------------------------|----------|-----|---------|-----|-------|------|-----|-----|
| Sample No.                                                             | Moisture | Ash | Protein | Fat | Fiber | NFE  | Ca  | P   |
|                                                                        | %        | %   | %       | %   | %     | %    | %   | %   |
| 1                                                                      | 13.5     | 3.1 | 25.4    | 3.2 | 8.4   | 46.4 | --  | --  |
| 2                                                                      | 6.9      | 3.4 | 25.0    | 2.6 | 10.0  | 52.1 | .38 | .39 |

The guar beans were rolled by a custom feed mill in Woodward to about the same degree of coarseness as rolled milo. A few whole beans could be found in the final product and there was very little meal. The steers appeared a little reluctant to eat the beans at first so about one-third pound of 41 percent cottonseed meal per steer was mixed with guar for about 2 weeks and then withdrawn. After that the steers ate the beans avidly.

Supplemental Winter Feeding Studies with Cows and Calves

In 1951, five groups of heifers were started on life-long studies to determine the most efficient type and rate of supplemental feeds for wintering cows on the native grasses in this region. Observations will be concerned with weaning weights of calves, calf crop percentage, weight of cows, and overall wintering and calf production costs.





The five feeding treatments were a daily ration per head of (1) 2 pounds of 41 percent cottonseed cake plus 2 pounds of rolled sorghum grain, (2) two pounds of cake, (3) two pounds of cake and no bonemeal, (4) two pounds of 41 percent cottonseed meal self-fed with salt, and (5) one pound of cake. All lots but one received free access to bonemeal and salt during winter.

The weight-gain and production records obtained to date must be considered as preliminary in character. These findings show that cows wintered on 2 pounds of 41 percent cottonseed cake hand fed, had the lowest 1954 fall body weight of all groups (774 pounds). Grass supplies were extremely low in all pastures at the close of the 1954 season and this group of cows suffered heavier weight losses than any other group through the final summer period. The reason for this heavy weight loss has not been determined since a nearly equal quantity of grass was available to all cattle.

Calf production records for the 2-year period were not greatly different except for those cows which were fed salt-meal and those fed only 1 pound of cake:

| Winter Supplement     | 2-Year Average |           |
|-----------------------|----------------|-----------|
|                       | Weaning Wt.    | Calf Crop |
|                       | <u>Lbs.</u>    | <u>%</u>  |
| 2# cake - 2# grain    | 386            | 91        |
| 2# cake - no bonemeal | 378            | 95        |
| 2# cake               | 360            | 95        |
| 1# cake               | 352            | 95        |
| 2# meal, self fed     | 353            | 86        |

The data suggests that the cows fed salt meal might be lower than average in fertility. This condition cannot be attributed yet to any specific cause; more data will be necessary before positive conclusions can be made.

\* \* \* \* \*

My countrymen have too little knowledge of the profits of grassland.  
George Washington





Preliminary Summary of Cow-Calf data during the 3-year period  
Fall of 1951 to Fall of 1954

| Items of Comparison                          | Winter Feeding Treatment |              |                    |            |            |
|----------------------------------------------|--------------------------|--------------|--------------------|------------|------------|
|                                              | 2#cake-No<br>bonemeal    | Salt<br>meal | 2#cake-<br>2#grain | 2#<br>Cake | 1#<br>Cake |
| <u>Cow Data:</u>                             |                          |              |                    |            |            |
| Body wt. as weaner heifers:11-15-51          | 467                      | 471          | 466                | 449        | 457        |
| Body wt. as long yearlings:11-4-52           | 754                      | 747          | 753                | 695        | 719        |
| Yearlong gain per head: 1951-52              | 287                      | 276          | 287                | 246        | 262        |
| Acres per head: 1951-52                      | 7.6                      | 7.6          | 7.6                | 7.6        | 7.6        |
| Body wt. near calving time: 3-1-53           | 830                      | 753          | 838                | 766        | 754        |
| Body wt. when calves were weaned:<br>10-6-53 | 933                      | 861          | 921                | 836        | 876        |
| Yearlong gain per head: 1952-53              | 179                      | 114          | 168                | 141        | 157        |
| Acres per head: 1952-53                      | 9.6                      | 9.6          | 9.6                | 9.6        | 9.6        |
| Body wt. near calving: 3-1-54                | 926                      | 874          | 937                | 842        | 852        |
| Body wt. on 10-1-54                          | 872                      | 867          | 903                | 774        | 839        |
| Yearlong gain per head: 1953-54              | -61                      | -5           | -16                | -65        | -39        |
| Acres per head: 1953-54                      | 10.8                     | 10.8         | 10.8               | 10.8       | 10.8       |
| <u>Calving Data: 1/ 1953</u>                 |                          |              |                    |            |            |
| No. of cows per treatment                    | 12                       | 12           | 12                 | 12         | 10         |
| No. of calves born                           | 12                       | 10           | 11                 | 12         | 10         |
| Percentage of fertile cows                   | 100                      | 83           | 92                 | 100        | 100        |
| No. of calves weaned                         | 10                       | 10           | 9                  | 12         | 10         |
| Average birth weight(sex corrected)          | 64                       | 60           | 68                 | 65         | 64         |
| Average birth date                           | Apr. 14                  | Apr. 4       | Mar. 31            | Apr. 10    | Apr. 16    |
| Average weaning wt.(sex corrected)           | 370                      | 356          | 375                | 367        | 333        |
| Lbs. of calf weaned per cow 2/               | 370                      | 297          | 344                | 367        | 333        |
| Lbs. of calf per acre 2/                     | 46                       | 31           | 43                 | 38         | 35         |
| <u>1954:</u>                                 |                          |              |                    |            |            |
| No. of cows per treatment                    | 9                        | 9            | 10                 | 10         | 10         |
| No. of calves born                           | 8                        | 8            | 9                  | 9          | 9          |
| Percentage of fertile cows                   | 89                       | 89           | 90                 | 90         | 90         |
| No. of calves weaned                         | 8                        | 8            | 9                  | 9          | 7          |
| Average birth wt. (sex corrected)            | 68                       | 71           | 72                 | 72         | 68         |
| Average birth date                           | Mar. 16                  | Apr. 13      | Mar.9              | Apr.3      | Mar.22     |
| Average weaning wt.(sex corrected)           | 386                      | 350          | 396                | 352        | 370        |
| Lbs. of calf weaned per cow 2/               | 343                      | 311          | 356                | 317        | 333        |
| Lbs. of calf per acre 2/                     | 32                       | 29           | 33                 | 29         | 31         |
| <u>SUMMARY:</u>                              |                          |              |                    |            |            |
| Gain per cow: 11-15-51 to 10-1-54            | 405                      | 385          | 439                | 322        | 380        |
| Av. wt. of cows: 10-1-54                     | 872                      | 867          | 903                | 774        | 839        |
| Lbs. of calf per cow(2 years)2/              | 358                      | 303          | 350                | 344        | 333        |
| Lbs. of calf per acre(2 years)2/             | 38                       | 30           | 38                 | 34         | 33         |

1/ Based only on cows that raised calves in the year reported upon.

2/ Based on fertile cows.





Fattening Steers on Native Range with Sorghum Grain

An opportunity may exist in the Southern Great Plains region whereby locally produced steers and locally produced sorghum grain may be combined into a successful pasture fattening operation, and at the same time aid in pasture improvement. To study this matter, three groups of steer calves were fed from November 13, 1953, to October 4, 1954, on 8-pound, 6-pound, and 4-pound levels of sorghum plus 1 pound of cottonseed meal. The steers were given free access to moderately grazed native range.

This work is considered in the nature of a pilot trial, insofar as rates and methods of feeding are concerned, since changes are anticipated as the work progresses. It is further planned to incorporate the most efficient level of feeding grain, as determined from these pilot trials and other studies, into a long-time project of feeding grain on pasture. The objective will be to measure range improvement as affected by returned fertility plus a study of the economy of pasture fattening operations in efficiently utilizing locally grown feeder steers and sorghum grain.

Preliminary results obtained during the past year were not particularly encouraging. None of the groups produced sufficient gain to reach slaughter condition, and economic analyses show a greater return for steers fed only cottonseed cake during the wintering period. Steers fed 6 pounds of sorghum plus 1 lb. of cake produced 1.46 pounds gain a day through the 325-day period. These animals exhibited the highest fleshy feeder condition at the close of the trial. It is believed that a change in the rate of feeding whereby a light ration will be fed during the winter and spring and a heavy rate during late summer will produce more desirable results.

Fattening Steers on Native Range with Sorghum Grain  
November 13, 1953 to October 4, 1954 -- 325 days

Daily ration:

|                       |     |     |     |                   |
|-----------------------|-----|-----|-----|-------------------|
| Sorghum grain, lbs.   | 8.0 | 6.0 | 4.0 | None              |
| Cottonseed meal, lbs. | 1.0 | 1.0 | 1.0 | 2.0 <sup>2/</sup> |

|                               |                 |                 |    |    |
|-------------------------------|-----------------|-----------------|----|----|
| <u>No. of steers per lot:</u> | 9 <sup>1/</sup> | 9 <sup>1/</sup> | 10 | 10 |
|-------------------------------|-----------------|-----------------|----|----|

|                                    |     |     |     |     |
|------------------------------------|-----|-----|-----|-----|
| <u>Initial weight:</u> 11-13-53    | 433 | 448 | 443 | 442 |
| Gain: Nov. 13 to Mar. 3 (110 days) | 86  | 83  | 68  | 56  |
| Gain: Mar. 3 to Apr. 20 (48 days)  | 81  | 78  | 69  | 61  |
| Gain: Apr. 20 to Oct. 4 (167 days) | 288 | 314 | 284 | 179 |
| Total gain - all periods           | 455 | 475 | 421 | 296 |

|                              |      |      |      |     |
|------------------------------|------|------|------|-----|
| <u>Final weight:</u> 10-4-54 | 888  | 923  | 864  | 738 |
| Daily gain (325 days)        | 1.40 | 1.46 | 1.30 | .91 |

Total Feeds:

|                       |      |      |      |                   |
|-----------------------|------|------|------|-------------------|
| Sorghum grain, lbs.   | 2311 | 1783 | 1192 | None              |
| Cottonseed meal, lbs. | 294  | 296  | 294  | 267 <sup>2/</sup> |

|                                           |         |         |         |         |
|-------------------------------------------|---------|---------|---------|---------|
| <u>Appraisal value of steers per cwt:</u> | \$20.50 | \$20.25 | \$20.00 | \$19.50 |
|-------------------------------------------|---------|---------|---------|---------|

Net returns per steer:

|                                 |         |        |         |         |
|---------------------------------|---------|--------|---------|---------|
| For feed, labor, and investment | \$-5.51 | \$9.65 | \$11.53 | \$14.51 |
|---------------------------------|---------|--------|---------|---------|

1/ 1 steer removed from lot -- shinnery oak poisoning.

2/ Cottonseed cake hand-fed during winter.





# Self Feeding of Salt-meal to Steers

Salt has been successfully used during the last 6 years to govern daily consumption of protein concentrates and meal-grain mixtures which were self-fed to beef cattle. A daily ration of about 1/2 pound of No. 4 crushed stock salt per head is required to regulate daily consumption of a 400 pound calf to 2 pounds of meal; slightly more salt is required for larger animals and slightly less for smaller ones. Slightly more salt is required as the season progresses because cattle seem to develop a taste tolerance for salt; they gain weight and become larger in body size, and lastly the forage becomes more scarce and poorer in quality.

Weaner steer calves self-fed salt meal during the past 6 winters, as shown below, have gained 16 pounds per head less during winter than comparable cattle hand fed. They have made similar gains during the summer, and 16 pounds less yearlong gain. Late-summer feeding of salt meal has resulted in equally as good gains as hand-feeding. No reduction in gains has occurred during summer.

## Self Feeding Salt-meal versus Regular Hand Caking

| Method of feeding                                   | Total feed per Head |      | Gain per Head |        |          |
|-----------------------------------------------------|---------------------|------|---------------|--------|----------|
|                                                     | Protein             | Salt | Winter        | Summer | Yearlong |
|                                                     | Lbs.                | Lbs. | Lbs.          | Lbs.   | Lbs.     |
| <u>Winter caking; 6-year average, 1949-54:</u>      |                     |      |               |        |          |
| Hand fed                                            | 282                 | ---  | 72            | 262    | 334      |
| Self fed                                            | 288                 | 79   | 56            | 262    | 318      |
| Advantage of hand feeding                           |                     |      | 16            | 0      | 16       |
| <u>Late summer caking; 5-year average, 1949-53:</u> |                     |      |               |        |          |
| Hand fed                                            | 98                  | ---  |               | 297    |          |
| Self fed                                            | 94                  | 41   |               | 291    |          |
| Advantage of hand feeding                           |                     |      |               | 6      |          |

Steer calves have consumed from 60 to 100 pounds of salt per head during a 150-day winter feeding period and about 50 pounds during a 90-day summer feeding period without ill effect. Possibility of causing ill effect from sudden heavy use of salt may be eliminated by increasing proportion of salt from a sprinkling at the outset to the quantity required to regulate self feeding, starting the practice by daily hand feeding.

Blood analyses from steers self-fed salt meal were no different from those of hand-fed cattle in calcium, phosphorus, chlorides, or hemoglobin. These analyses were made by the Agricultural Chemistry Research Department of the Oklahoma A. & M. College.

Salt meal can be successfully fed in open feed bunks. Several ranchers in the vicinity of Woodward have used this method during the past 4 years. Little rain falls during winter in the Southern Great Plains; and when it does, it seems to "puddle" the salt meal and run off, rather than to penetrate and spoil the mixture. Livestock quickly remove the damp top layer and soon begin to eat bright, dry meal.

Feeding salt meal away from water and in undergrazed areas can aid materially in cattle distribution. Self-feeding of salt meal 1/4 to 1/2 mile away from water has not been injurious to livestock. Animals fed away from water have made similar





gains to cattle self-fed near water, both in summer and in winter feeding trials. The cattle fed away from water have required slightly less salt, about 1/8 pound per head daily, to govern their consumption.

Self feeding salt meal represents an economical as well as an efficient method of getting protein supplements to cattle under range conditions. It is not fool-proof, however, and good management requires that the salt-mix bunkers be located where they are accessible to cattle at all times and can be given adequate service. For more complete information on salt-meal feeding, see the Station report entitled, "Salt as a Regulator of Meal Consumption by Cattle" by D. A. Savage and E. H. McIlvain, prepared February 1954.

#### Phosphorus and Other Minerals

Steers in triplicate pastures were fed a mineral mixture containing 1 part of steamed bonemeal to 3 parts of salt by weight in comparison with 3 other lots fed salt alone. This study was conducted during the 3-year period 1944 to 1946. The animals had free access to the minerals at all times, and they were grazed in the same manner to reduce forage differences to a minimum.

The average gains showed no advantage from feeding the phosphorus supplement. This indicates that steers wintered on native range in this locality usually do not require phosphorus when fed cottonseed cake which is high in phosphorus. Winter feeding of bonemeal or other phosphorus supplements may be advisable when the range forage is poor in quantity or quality, or when it is supplemented with soybean meal or other protein feeds low in phosphorus. Since cows have a higher phosphorus requirement than steers, it is probably safe insurance to make phosphorus supplements available to breeding herds in this region.

Calcium (lime) supplements are not needed on native range in this area since an excess is present in forage throughout the year. Feeding calcium to cattle tends to reduce the available phosphorus and thus increase or create a phosphorus deficiency. It is not advisable to feed ground limestone or other high calcium feeds to cattle grazing on native range in this area.

#### Sorghum as a Forage Supplement

Standing sorghum, bundle-feed, baled sorghum hay, and silage are fed in this region with excellent results. Several comparisons on the experimental range show conclusively that forage sorghum is a valuable crop for beef cattle in this area. A group of 47 yearling steers was grazed on growing African Millet sorgho from August 21 to October 14, 1950, a period of 53 days. Their initial weight was 663 pounds, and they gained 115 pounds per head, a daily average of 2.17 pounds. Similar steers grazed on native range gained 1.12 pounds daily during the same period.

Satisfactory gains were obtained from grazing sorghum in early winter. A group of 171 weaner calves grazed on African Millet sorgho from November 15, 1950, to January 16, 1951, and then on native range until April 15, 1951, gained 87 pounds. They were fed a total of 254 pounds of cottonseed cake during the winter. A total of 407 comparable steers was wintered on native range and fed similar quantities of cottonseed cake. They gained only 53 pounds during the same period. As shown in the economic analyses of reseeding grasslands, grazing returns from a properly established sorghum crop will nearly pay for reseeding abandoned cropland to grass.

Although there have been no deaths or sickness from Prussic acid poisoning on the Experimental Range, there is always some danger of grazing sorghums, parti-





cularly when green. Normally there is little or no danger after the plants are killed by freezing. The sorghum can be "tested" for Prussic acid by grazing it with a few animals. If no trouble occurs after an hour of grazing, it is usually safe to turn in the remainder of the herd. Sodium thiosulfate injection or drench is usually a successful remedy if administered promptly after an animal is stricken.

#### CATTLE PARASITE CONTROL

INVESTIGATIONS to determine practical methods for controlling external parasites of cattle have been conducted in cooperation with D. E. Howell, Head of the Entomology Department, Oklahoma Agricultural Experiment Station, since 1946. Studies were made on effects of horn fly and grub control on steer gains, and on efficiency of different chemicals and methods of application for controlling horn flies, grubs, lice, and ear ticks.

Horn flies: DDT and Toxaphene gave excellent results in the control of horn flies. Steers sprayed with two quarts of 0.5 percent DDT (8 pounds of 50 percent wettable powder in 100 gallons of water) remained practically fly-free for a month. Spraying only the top line of the animals provided as good control as overall spraying and required much less labor and materials. Steer gains from 5 monthly sprayings with 0.5 percent DDT were determined in summer of 5 years. Spraying increased steer gains an average of 16 pounds. The greatest differences in steer gains, 27 pounds, occurred when flies were most numerous.

Rubbing posts, both commercial and homemade, have been extremely effective in horn fly and lice control at Woodward. The cattle treated themselves by rubbing against a 4-percent solution of DDT in low-grade, new motor oil. This solution can be made by dissolving 2 pounds of 100 percent technical DDT (or its equivalent in prepared DDT-oil or wettable powder solutions) in 6 gallons of new, low-cost motor oil. The resultant fly control has been superior to that obtained from spraying, and costs are only about 1 cent per head for a 6-month period.

Commercial rubbing posts are available from several sources. Effective "homemade rubbing posts" can be made from several strands of old barbed wire, burlap sacks, and a means of support. A "cable" is made of the barbed wire. This is then wrapped with burlap sacks, and one end is firmly fastened to a post about  $4\frac{1}{2}$  feet from the ground. The other end is fastened near ground level about 12 feet out from the post. The burlap "cable" is then treated at monthly intervals with 1 pint of 4-percent DDT solution in motor oil. The key to successful fly control is to locate the "post" where cattle naturally congregate.

Stockmen using these parasite-control devices should be aware of the potential danger of "X" disease, a new malady characterized by loss of hair, thickening of the skin, watery eyes, running noses, emaciation, and death. One of the causes of this disease has been determined to be chlorinated naphthalene, an ingredient of a very few petroleum products. Should such a disease occur in a herd, all animals should be removed immediately from all possible sources of petroleum products until the exact cause has been determined. A low-priced, bland, industrial oil, free from any possible contamination by chlorinated naphthalene is available on the market and recommended for use by livestock on rubbing posts.

Grubs were effectively controlled just prior to emergence by pressure spraying each animal with 1 gallon of solution containing  $7\frac{1}{2}$  pounds of 5 percent rotenone per 100 gallons of water. The animals were sprayed 3 times at monthly intervals, starting about November 30. Steers so treated for grub control in 1946, 1947, and 1949 averaged 5 pounds more winter gain than comparable steers





not sprayed. This resulted in an average profit of 79 cents per head for the 3-year period. However, the profit in 1947-48 was \$2.90 per head when spraying increased steer gains 13 pounds per head. Main advantage of the treatment is realized when it is applied on a community-wide basis for elimination of heel flies from an area.

Lice frequently infest range cattle and cause economic loss. They can be controlled with the rubbing post described for fly control; or by dipping or overall spraying with a suspension of 10 pounds of 5 percent rotenone per 100 gallons of water, or with 8 pounds of 50 percent wettable DDT per 100 gallons of water. One application of DDT, preferably in the form of a dip, or 2 applications of rotenone 3 weeks apart in early winter are required for effective results. The poor condition of lousy cattle leaves no doubt as to the benefits of lice control.

Ear ticks in weaner calves often cause drooping ears and other symptoms similar to shipping fever. Occasionally infested animals become seriously ill. These ticks are common in the Southern Great Plains, but are often overlooked in the control of external parasites. They can be effectively controlled with a 1-percent solution of BHC in used crankcase oil. This is prepared by adding 1-part of 20 percent Lindane to 19 parts of oil. An oil can equipped with a thumb-operated pump is an efficient means of squirting a small quantity of the chemical in each ear, which should then be rubbed well so the liquid will enter the small crevices. This procedure has given excellent results when used once each fall.

#### MISCELLANEOUS STUDIES

Effects of initial weight at weaning time upon subsequent gains on native range have been very small. A total of 395 steers were similarly grazed in 6 yearlong pastures during a 5-year period. They were classified into four 50-pound weight classes on basis of initial fall weight. Average weight of the steers in the lightest weight class was 334 pounds. Steers in this class gained 7 pounds more in winter, 16 pounds less in summer, or 9 pounds less yearlong than the heaviest class which initially weighed 471 pounds.

An important comparison of the relative gaining ability of light and heavy weaner calves is indicated by this study. Light-weight calves, which represent a smaller initial investment, made essentially the same gains as steers weighing 150 pounds more at weaning. Thus, when interest on investment is considered, the lighter calves would appear to be more profitable if other factors are equal.

Effects of feeder grade on winter, summer and yearlong gains were studied during the 4-year period, 1942 through 1946. All cattle used on the Experimental Range were scored as to feeder grade by a committee of animal husbandmen at the start of each season. The gain differences between feeder grades was very small. Steers graded as "medium good" in the fall made 6 pounds more winter gain than either the "high goods" or the "low goods." Steers graded as "low good" in the fall made the greatest summer and yearlong gains but the difference was too small to offset the higher quality of meat and superior appraisal price of the higher grading groups.

Effects of winter gain on subsequent summer gain have been studied during a 9-year period. These tests have well illustrated the principle that steers wintered on different planes of nutrition tend to equalize in weight the following summer. Steers which made low winter gains due to lack of nutrients usually made more summer gain, but slightly less yearlong gain, than well-wintered steers.





Less known, however, is the principle that winter, summer, and yearlong gains of steers are governed largely by heredity when the animals being compared are grazed uniformly as one herd under similar conditions of feed and environment. Under these conditions, steers which made low winter gains also made the lowest summer and yearlong gains.

Effects of steer color on gains were studied during the 4-year period, 1946 to 1949, by classifying all experimental steers as to light-red, intermediate-red, and dark red color shades. Gains were then computed for each class. The study was made to answer frequent inquiries of stockmen as to the relative gaining ability of light and dark color Hereford cattle. The average of 1796 steers showed no significant difference in seasonal or yearlong gains of the different color types.

#### COOPERATION

The writers gratefully acknowledge the helpful cooperation of the following individuals and firms in conducting current phases of these investigations: V. G. Heller, J. E. Webster, and R. W. MacVicar of the Oklahoma A. & M. College; Leslie E. Johnson and R. T. Clark of the Animal and Poultry Husbandry Research Branch, ARS, USDA; Jack Engleman, Fred Whittington, and Tom Elder of the Soil Conservation Service; Ed Rowley of the Woodward Soil Conservation District; H. C. Hyer, Bill Taggart, Miss Willa Dean Nicholson and many County Agents of the Oklahoma Extension Service; J. O. Wells, Paul Hatcher, Del Randall, Alford Myers, the H. C. Hitch Ranch, Carl Wood, Elmer Monson, Clark Mather, Pat Hamilton, A. L. Thurmond, and Tom Britt, all ranchmen of the region; C. G. Frye and Jack Welsch, airplane spraying operators; Jake Simms of Simms Livestock Commission Co.; the Salt Producers Association; the American Chemical Paint Co., the Dow Chemical Co., the Dupont Chemical Co., and the International Steel Co.



## SCOPE AND OBJECTIVES OF THE STATION

The U. S. Southern Great Plains Field Station, a research agency of the U. S. DEPARTMENT OF AGRICULTURE, was established in 1913 for dry-farming investigations. For many years it has been a center of research on sorghums, windbreaks, homestead plantings, small grains, rotation and tillage tests, and horticultural crops. In 1936 it became the headquarters for grass breeding, regrassing, and range and pasture-improvement studies conducted by the Bureau of Plant Industry in the five-state region. This work is now being conducted by five agencies of the newly organized AGRICULTURAL RESEARCH SERVICE. These include the BRANCH of (1) Field Crops Research, (2) Horticultural Crops Research, (3) Soil and Water Conservation Research, (4) Production Economics Research, and (5) Animal and Poultry Husbandry Research.

The Station includes 920 acres near the headquarters at Woodward, 4,315 acres on its Southern Plains Experimental Range north of Fort Supply, and conducts additional experimental work in cooperation with farmers, ranchers, and other stations in the area. Principal lines of investigation and personnel in charge of each are listed below:

E. H. McILVAIN, Superintendent

J. J. Brenner, Station Foreman

C. G. Armstrong, Range Foreman

P. L. LaMunyon, Administrative Assistant

RANGE MANAGEMENT AND GRAZING STUDIES

E. H. McIlvain, C. G. Armstrong,

J. J. Betzen, L. F. Robertson

GRASS AND LEGUME BREEDING

J. R. Harlan, W. R. Kneebone,

H. W. Brown, C. R. Pearson

TREES, SHRUBS, VINES AND WINDBREAKS

E. W. Johnson, G. C. Vanderslice

SOILS AND HORTICULTURAL STUDIES

L. F. Locke, C. H. Sage

SORGHUM AND BROOMCORN IMPROVEMENT

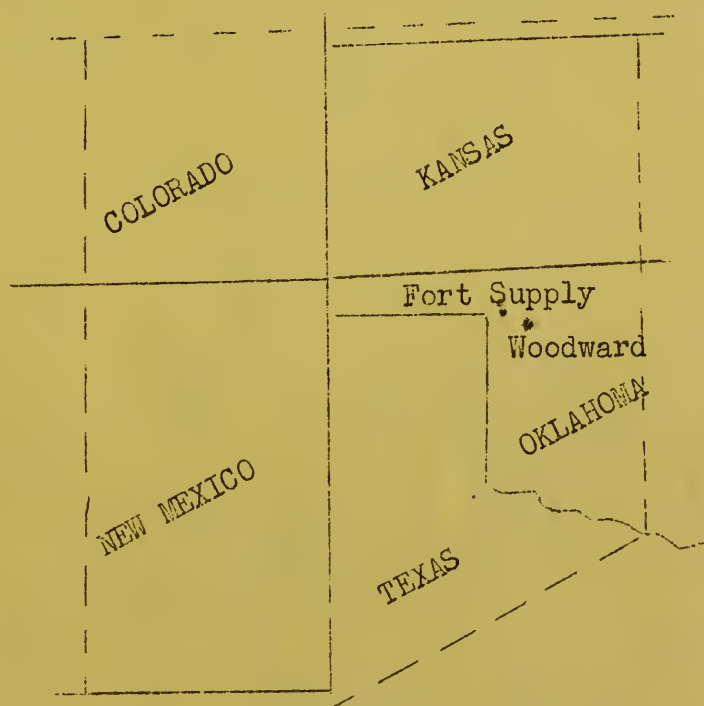
J. B. Sieglinger, R. A. Hunter

SMALL GRAIN IMPROVEMENT

A. M. Schlehuber, R. A. Hunter

ANIMAL AND PASTURE HUSBANDRY STUDIES

A. L. Baker



Region served by the Woodward Station



